

PUBLIC WORKS

CITY

COUNTY

STATE



Comparative sizes of new George Washington Bridge and old Brooklyn Bridge

In This Issue:

REINFORCEMENT IN CONCRETE PAVEMENTS AND BASES

NEW TYPE ASPHALTIC CONCRETE PAVEMENT IN OHIO

PERMANENT CONNECTIONS FOR MUDJACKING PAVEMENTS

ROLLING HIGHWAY EMBANKMENTS

TAR ROAD INVESTIGATIONS

THE WATER WHEEL

60-INCH CLAY LINED CONCRETE SEWER

WATER CONSUMPTION DURING FIRES

NEW DEARBORN SEWAGE TREATMENT PLANT

TESTING A 10-INCH WELL

CANTON USES LIQUID SLUDGE

STABILIZING PUBLIC CONSTRUCTION WORK

HOW ONE COMMUNITY PLANS FOR UNEMPLOYMENT RELIEF

CITIES GIVING EMPLOYMENT THROUGH PUBLIC WORKS

PUBLIC WORKS

HERCULES

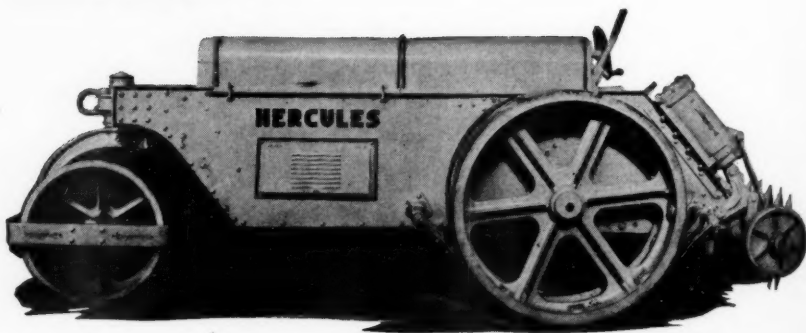
PIONEERS AGAIN!

**INTRODUCING THE HERCULES
CRAWL TRACTOR**



**THE SAME
MACHINE FOR
MANY DIFFERENT
PURPOSES!**

Hercules Crawl Tractor
(above) and the Same
Machine Converted
to a Roadroller



THE SENSATION OF THE YEAR!

**It does everything but stand on its head
or lay down—and we mean just that**

THE HERCULES COMPANY
MARION, OHIO, U. S. A.

ACTIVE DISTRIBUTORS WRITE OR WIRE FOR TERRITORY

VOL. 62

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NOVEMBER, 1931

No. 11

JUST WHAT DO YOU WANT A CLAMSHELL BUCKET TO DO?

If Your Demands Are
Here . . . You'll Want
To Know More About
An Owen

If you want a bucket that will tackle every job you give it, and get through with it in the shortest time—

If you want a bucket that digs straight down, deep into the material, grabs a capacity load every time, dumps clean—with no waste motion—

If you want a bucket that does a "bigger day's work than any other bucket of the same weight and capacity" and that, assured by positive guarantee—

If you want a bucket that stands up under hard work with no breakage, and that gives longer life—

If you want a bucket that pays for itself in time saved and extra yardage—

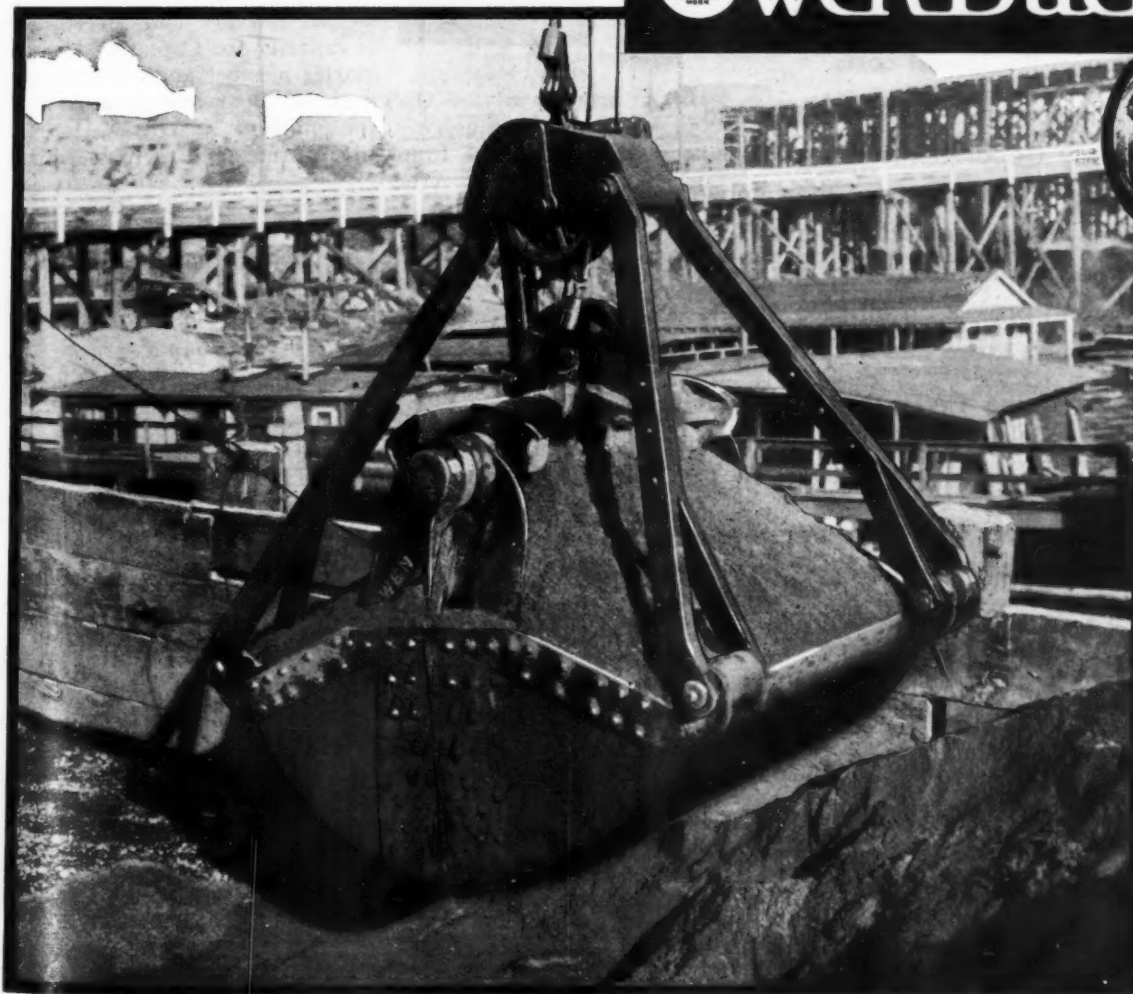
You'll want an Owen—because Owen Buckets are making good in all of these requirements for satisfied owners, everywhere.

Get down the particular kind of work a clamshell bucket must do for you and we'll send you some valuable data on the Owen that will pay for itself doing it for you.

The Owen Bucket Co., 6012 Breakwater Ave., Cleveland, O.



Owen Buckets



A .
MOUTHFUL
AT EVERY
BITE

POSITIVE TRACTION

**Makes FWD Truck a big favorite
FOR SNOW REMOVAL WORK**

Keeps Highways Open at Lowest Cost

The FWD is just a good, powerful, economical sure-footed truck, different in principle . . . and when equipped with a good snow plow, you have a winning combination that will keep your roads open at the lowest costs.

That's why the majority of State, County and Township Highway Departments in the "Snow Belt" use FWDs in large fleets . . . they know that the FWD is exceptionally powerful . . . it puts all of the power developed to actual use . . . it drives and brakes on all four wheels . . . it pushes through those heavy drifts.

The advantages of the FWD Truck are embodied in a booklet, written on "Snow Removal". Write today for your copy, Dept. B.

THE FOUR WHEEL DRIVE AUTO COMPANY
Clintonville, Wisconsin . . . Canadian Factory: Kitchener, Ontario



*This booklet gives
you the FACTS.
Write for it!*



BACKED BY NATION-WIDE SERVICE

When writing, please mention PUBLIC WORKS

With Our Authors



C. W. MOWRY is manager of the Inspection Department of the Associated Factory Mutual Fire Insurance Companies, with headquarters in Boston. Mr. Mowry, who is the author of the article in this issue on "Water Consumption During Fires" was graduated from Massachusetts Institute of Technology, in mechanical engineering, in 1906. For twenty-five years he has been with the Factory Mutual Fire Insurance Companies, both in the hydraulic laboratories and in the field, as fire protection engineer investigating fire hazards in industrial plants and laying out water supplies for fire protection.

Mr. Mowry, who is a familiar figure at the water works conventions, is to be congratulated on the painstaking manner in which he has gathered together the valuable information given in his article.



AUGUST SAUER has had a wide experience in municipal engineering, mainly with the City of Philadelphia, and is now in charge of architectural and structural design for the Engineering and Development Department of the Sun Oil Co. He served fifteen months in the army during the war and now holds a certificate of capacity for Captain. He is a charter member and assistant secretary of the Order of the Boar and a member of other engineering and military societies. He is a graduate of Franklin Institute, Philadelphia, School of Mechanic Arts.



P. L. Brockway



John Simpson

**OTHER
AUTHORS
IN
THIS
ISSUE**



James S. Burch



Jack J. Hinman, Jr.

TO HELP YOU IN YOUR WORK, ANY OF THIS
INDUSTRIAL LITERATURE

WILL BE SENT **FREE** UPON REQUEST

It is a good practice to check this list regularly because descriptions of new bulletins are always being added.

Construction Methods and Equipment

Accessories, Motor Truck

1. Truck accessories—winches, power take-offs, derricks, special bodies, earth boring machines, and trailers of all capacities are described in a series of folders issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Asphalt Heaters

8. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools and their use in road construction.

9. "Hotstuf," the master oil burning heater, is the only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Described in illustrated manual No. 11—Mohawk Asphalt Heater Co., 94 Weaver St., Schenectady, N. Y.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue a booklet for use and specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate.

Asphalt Rollers

12. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

Clamshell Buckets

27. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Clamshell Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Clamshell Buckets will also be furnished on request.

28. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes a 32-page catalog descriptive of all types of Blaw-Knox Dreadnaught Clamshell Buckets, No. 1234, illustrating various construction features and giving a complete list of types and sizes. A complete catalog on

Blaw-Knox Dragline Buckets, No. 1247, will also be sent upon request.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subjects suggested by its title. A well-illustrated and instructive volume.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Published by the Solvay Sales Corp., 61 Broadway, New York, N. Y.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Copies will be supplied to those who ask for it. Issued by Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Jaeger Concrete Mixers, both Tilting and Non-Tilting types, from 3½ to 34½ size, with illustrated descriptions of all types mounting, power and loading equipment—64 pages published by The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallion Iron Works & Mfg Co., Gallion, Ohio.

Culverts—Large Diameter

59. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to all kinds of drainage problems, will be gladly sent free upon request. Address Toncan Culvert Mfrs. Assn., Massillon, Ohio.

60. Ease and speed of installation, economy, a full-width roadway and durable, maintenance-free service, are listed in the new catalog, "Armco Large Diameter Corrugated Pipe," as the advantages following the use of larger diameter culverts in meeting small bridge requirements. Catalog No. 8 will be sent free on request. Address Armco Culvert Mfrs. Association, Middletown, Ohio.

Dump Wagons, Steel

70. Steel Dump Bodies and hydraulic hoists for Fords and other small trucks are described and fully illustrated in technical literature published by the Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

71. "Steel Dump Bodies." Full data on steel dump bodies for every type of hauling proposition and description of special

"Self-Dumper Bodies" for road Builders. Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

Finishing Machine

74. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Bulletin No. 6, completely descriptive of the Ord Road Finisher and its application to the finishing of all types of concrete and asphalt pavements. This bulletin will be sent upon request.

75. Complete description of Lakewood Finishers, showing use of single and tandem screeds and tamper attachment for high speed production on concrete and bituminous pavements, city streets and highways—32 pages published by The Lakewood Engineering Company, Columbus, Ohio.

Graders

76. "Blade Graders" is a 48 page booklet, recently published by the Caterpillar Tractor Co., Peoria, Ill., giving the complete details of the "Caterpillar" graders which are built to set new records in yards of earth moved, in miles of road maintained per dollar expended.

Excavating Buckets

80. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Excavating Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Excavating Buckets will also be furnished on request.

Hammers, Self-powered

82. A new bulletin describing and illustrating the use of RODAX, a portable self-powered, gasoline driven hammer, has just been issued by the Rodax Corp., 2199 Lumber St., Chicago, Ill.

Hoists, Truck

85. "Dump Truck Hoist." Double the Truck's value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company, Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service available from the Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Lanterns and Torches

90. Send for interesting catalog in colors of Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.



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PUBLIC WORKS

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Please send me without obligation the following catalogs listed under INDUSTRIAL LITERATURE SECTION:

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Loaders and Unloaders

97. Link-Belt Company, Philadelphia, describes a line of Portable Loaders and Unloaders in Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076. Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities.

100. Link-Belt Co., Chicago, Ill. General Catalog No. 500, describing the entire line of Link-Belt Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery.

Motor Trucks

106. "Operating Trucks Profitably in Contracting"—A 24 page survey with practical data on efficient truck operation and what to consider in selecting new equipment just published by General Motors Truck Company—Pontiac, Mich.

107. The new "Operating Record for Motor Trucks" just issued by Dodge Brothers Corp., Detroit, Mich., is one of the most complete record books available. It includes the necessary forms and directions for a very accurate and detailed accounting of Motor Truck operations.

108. Four-wheel-drive trucks to increase the range of truck operation and for economy of operation for use in road building and maintenance, described in a series of new folders just issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Paving Materials

109. A 36 page booklet with 66 illustrations has just been issued by the Barrett Co. giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs, 24 pages. The Barrett Company, 40 Rector Street, New York.

Pumps, Contractors'

120. Humdinger contractors' pumps. Diaphragm pumps in both the open discharge and the diaphragm force pump types. Self-priming Centrifugal pump, for automatic continuous prime on suction lifts up to 28'. Are described fully and valuable practical information for contractors is given in special Bulletins #107-A and 1034. Ralph B. Carter Co., 53 Park Place, New York, N. Y.

Road Construction

121. "Road Construction and Maintenance" are covered in a new Cletrac Booklet, which takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, Ohio.

122. "Road Building Machines" is a handy reference booklet to the complete line of "Caterpillar" road machinery. 40 pages, illustrating the machines at work under many conditions. Issued by the Caterpillar Tractor Co., Peoria, Ill.

Road Rollers, Scrapers, Graders, etc.

124. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Bulletin No. 1310 descriptive of Blaw-Knox Dirt Moving Equipment including the Blaw-Knox "Ateco" Dirt Mover, the Blaw-Knox Wagon Grader, Scarifiers, Bulldozers and Tamping Rollers. This bulletin contains a complete description of the equipment and valuable cost data on dirt moving. It will be sent upon request.

126. Illustrated catalogs and descriptive material HERCULES, 6-cylinder road roller. Gasoline engine. Sizes 6, 7, 8, 10, 12, and 15 tons. Three speeds forward and backward. The Hercules Company, Marion, Ohio.

127. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

128. A beautiful 32 page book in four colors featuring their entire line of road rollers has been published by the Buffalo-Springfield Roller Co. of Springfield, Ohio. 8 1/2 x 11, leatherette cover, numerous action pictures.

129. An interesting booklet on Elevating Graders has recently been issued by the Caterpillar Tractor Co., Peoria, Ill. Illustrated, printed in 2 colors, it contains comparative specifications, tells of the construction and materials used, explains why they have the enviable reputation for capacity and for staying on the job.

131. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers. The Buffalo-Springfield Roller Company, Springfield, Ohio.

132. "Road Machinery." A sixty-four page data book has been issued by the Austin-Western Road Machinery Company, 400 No. Michigan Ave., Chicago, describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Scarifiers. Crushing plant equipment, small road tools. Special bulletins on each separate piece of machinery supplement the general catalog.

133. "Road Rollers." New illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Gallon Iron Works and Manufacturing Co., Gallon, O.

134. 36-page, illustrated book describing mechanical features of Huber 4-cylinder Motor Roller and its application to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

135. Road Machinery Illustrated. New illustrated bulletins on the master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders. Gallon Iron Works & Mfg. Co., Gallon, O.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Shovels, Cranes and Excavators

142. The Cranemobile, "successor to Trench Cranes," an adaptation of the crawler mounted Bay City Tractor Shovel is fully described and illustrated in Bulletin C2 just issued by Bay City Shovels, Inc., Bay City, Mich.

145. Catalog K3 just issued, completely describes the light half yard and the full half yard convertible shovel, crane, dragline, trench hoe and skimmer manufactured by Bay City Shovels, Inc., Bay City, Mich. 28 pages, over 50 illustrations, action pictures and charts.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines.

151. The complete line of 1/2-yd. to 1 1/2-yd. shovels, cranes, draglines, ditchers and skimmers manufactured by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., is described in Bulletin 60, which also gives lifting capacities and working ranges for the different sizes and types of these crawling tread machines.

Steel Forms

155. A well illustrated catalog of Steel Forms for concrete road, curb and sidewalk construction is available from The Heltzel Steel Form & Iron Company, Warren, O.

Steel Bins

159. Steel bins and measuring hoppers are included in a fully illustrated catalog of Contractors Equipment issued by The Heltzel Steel Form & Iron Company, Warren, Ohio. Write for your copy.

Steel Posts

160. Steel Posts for all purposes. Sweet's Herculean Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Steel Storage Bins

162. The Blaw-Knox Company, P. O. Box 915, Pittsburgh, Penna. publishes Catalog No. 1302, descriptive of the complete line of Blaw-Knox Contractors Equipment including steel storage bins, measuring equipment for proportioning concrete aggregates, cement and water, ready-mixed concrete plants, truckmixing and agitator bodies. This catalog will be sent upon request.

Surveying Instruments

163. A complete catalog and instruction book pertaining to the "Sterling" surveying instruments illustrated, is now ready for distribution by the Warren Knight Co., 136 No. 12th St., Philadelphia, Pa.

Tires, Truck and Car

165. Solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Full information and data available from Government Sales Department of the Good-year Tire & Rubber Company, Inc., Akron, Ohio.

Tractors, Crawler

168. The "Caterpillar" Ten tractor is fully described and illustrated in a 40 page booklet just issued by the Caterpillar Tractor Co., Peoria, Ill. 43 illustrations.

169. Cletrac crawler tractors. Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, O. Bulletin 562 describes their use in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, oil field work and lumbering. Made in "20," "30," and "40" and "100" sizes.

170. "The Twenty" is the title of a new booklet just issued by the Caterpillar Tractor Co., Peoria, Ill., which tells the story of the design and construction of the "Caterpillar" Twenty and illustrates points in the tractor itself that are translated into superior performance.

172. A 32 page catalog with 42 illustrations has just been issued by the Caterpillar Tractor Co., Peoria, Ill., describing the "Caterpillar" Sixty. Gives complete details regarding construction, specifications and special equipment.

173. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, 19322 Euclid Ave., Cleveland, Ohio. Cletracs range in size from the 12 h. p. model to the powerful 100 h. p. tractor.

Truck Cranes

182. Full-revolving, gasoline-operated Truck Cranes with a capacity of 7 1/2 tons at a 10 ft. radius, for mounting on a 5-ton or 7 1/2 ton auto-truck, are described in Bulletin 62, issued by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Truck Hoists

183. "Dump Truck Hoists." Double the Truck's Value by using power operated Hydraulic Hoists. Booklet published by WOOD Hydraulic Hoist and Body Company, 7924 Klopelle St., Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Combining Superior Strength with Maximum Durability and Resistance to Weather and Storms—

SWEET'S STEEL POSTS

are ideally adapted for your caution or warning signs, highway route markers, street or road intersections signs, etc.

Sweet's Steel Co.

Write for descriptive folder

Williamsport, Pa.



These 72-inch diameter Toncan Copper Molybdenum Iron Culverts took the place of a 26-ft. span bridge near Uxbridge, Ontario, effecting a saving of \$3000.00.



—the mark of durability on a culvert

All lines of industry acclaim the enduring qualities of Toncan. In locomotive boiler tubes, in railroad cars, in plates and rivets on ships, wherever conditions are severe, Toncan has proven its superiority.

Made by the world's largest producers of alloy irons and stainless steels, Toncan is today recognized as the longest-lived commercial metal for culvert purposes. The copper and molybdenum alloyed with Toncan's pure iron base combine to produce a composition and structure far surpassing any competitive product in corrosion and rust resisting qualities. To buy Toncan Copper Molybdenum Iron Culverts is to buy satisfactory culvert service for years and years to come.

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MANUFACTURERS' ASSOCIATION
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Plants Located in All Parts
of United States and Canada

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 5

Road and Street Maintenance

Asphalt Heaters

201. Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches and Hand Spraying Attachments. Full data. Connery & Company, Inc., of Philadelphia.

202. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa., has issued a new Bulletin "J" describing the latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments.

203. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables and composition, grading, etc.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost.

Equipment

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line, has just been issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

216. "Light and Heavy Road Maintenance" is the title of a recent folder showing the tremendous power developed by the FWD truck and its economy for use in pulling road graders and maintainers—issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin.

Highway Mowers

217. A new Motor Sickle Highway Mower, cutting from eight to twenty miles per hour, has been designed for mowing highways. Has a cruising speed while not mowing up to fifty miles per hour over smooth surface roads. Full details on construction and operation from Rawls Mfg. Co., Streator, Ill.

Maintenance Machines

218. "Maintenance Machines," a 32 page booklet, profusely illustrated, tells of the design and construction of "Caterpillar's" complete line of maintenance machines—3 sizes of motor patrols, a trailer patrol and planer—including machines to fit all pocketbooks and all road maintenance conditions. Issued by the Caterpillar Tractor Co., Peoria, Ill.

Surface Heaters

220. The new "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is fully described and illustrated in Bulletin 16 just issued by the Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Road and Paving Materials

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material may be obtained from the National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of con-

crete pavements. A handy, useful volume, well illustrated. 47 pages, 5½x7½. The Dow Chemical Company, Midland, Mich.

Culverts, Corrugated

236. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to all kinds of drainage problems, will be gladly sent free upon request. Address Toncan Culvert Mfrs. Assn., Masillon, Ohio.

Culverts—Corrugated Metal

238. A new 24-page, well-illustrated catalog, listing the advantages that follow the use of Armco corrugated iron culverts and containing complete instructions for ordering and installation has been published by Armco Culvert Mfrs. Association, Middletown, Ohio. Write for Culvert Catalog No. 6.

Jacking Method

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. A new catalog, "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products is now ready for distribution. Recently published by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

273. Complete directions for surface treatment and bituminous surfacing with Cut Back Asphalt are contained in a 36 page data book just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

Material Handling Buckets

280. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Material Handling Buckets, showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Material Handling Buckets will also be furnished on request.

Sand and Gravel Buckets

290. The Owen Bucket Company, Cleveland, Ohio, have available illustrated folders on Sand and Gravel Buckets showing the various types, sizes and uses for which they are intended and construction features and other valuable bucket information. A complete catalog on all types of Sand and Gravel Buckets will also be furnished on request.

Garbage and Refuse Disposal

304. The Holzbog line of sanitary wagons especially designed for low cost collection of wet or dry garbage and refuse is fully described and illustrated in a 16 page catalog published by Geo. H. Holzbog & Bro., Jeffersonville, Ind.

305. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 3479 Neville Island, Pittsburgh, Pa., is described fully in a booklet sent on request.

Snow Removal

Snow Fences

347. A new folder giving full details regarding use and construction of the Mattson snow fence has just been issued by the Mattson Wire & Mfg. Co., Joliet, Ill. Illustrated in two colors.

Snow Removal

348. "Winter Maintenance" is the title of a recent booklet issued by Dept. B, Four Wheel Drive Auto Company, Clintonville, Wisconsin. Illustrates many types of snow plows and methods of handling snow removal problems.

349. "The Answer to the Snow Removal Problem" is the title of a new booklet just published by Carl Frink, Mfr., of Clayton, N. Y. It gives full details of the new Frink type S snow plow for trucks.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, Ohio.

354. "Snow Removal Equipment," a colorful booklet just off the press of the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill. Various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action.

355. "Conquering Snow With Caterpillars." "An Unwelcome Visitor Is Coming." "A Wall Ten Miles High." Three publications on the snow problem by the Caterpillar Tractor Co., Peoria, Ill.

358. The new Type "S" Frink Snow Plows and Frink Leveling Wings, together with complete data for selecting the proper size snow plow for your particular make and model of truck. Published by Carl H. Frink, Clayton, N. Y.

359. Gallon Iron Works and Mfg. Co., Gallon, Ohio, will gladly furnish details, prices and catalogs of their snow plows adaptable to any make of truck.

Sewerage and Sewage Disposal

Activation and Aeration

390. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Joining Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Company, Mertztown, Pennsylvania.

Sewer Joint Compound

404. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight are contained in an illustrated folder just issued by the Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Pumps—Sewage

410. Non-clog vertical and horizontal sewage pumps are fully described and illustrated in new bulletins just issued by the Dayton-Dowd Co., Quincy, Ill.

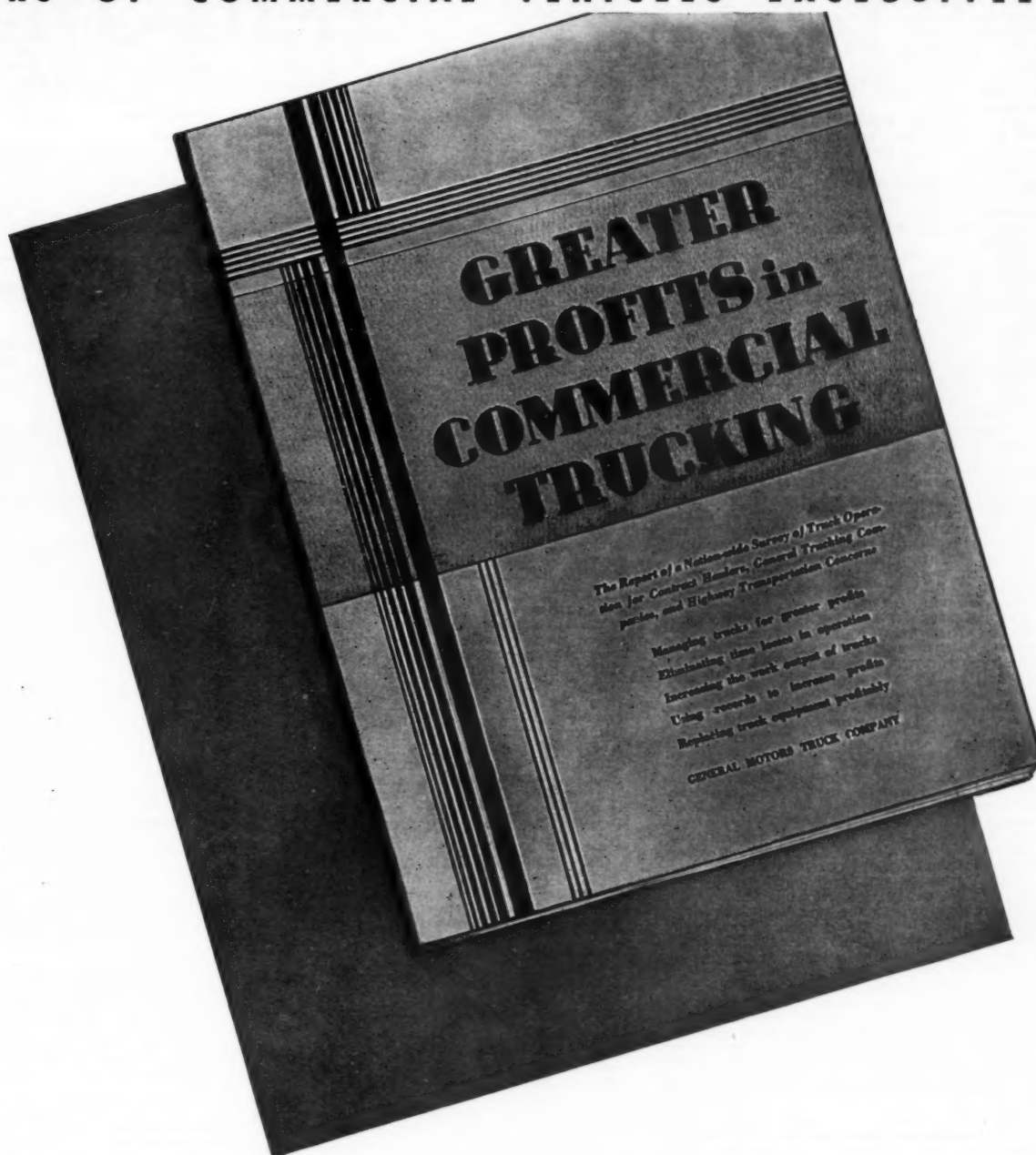
411. Full information regarding sewage pumps is given in publication 210, and a large number of sewage pump installations are illustrated and described in publication 193. The American Well Works, Aurora, Ill.

Sewage Screens

414. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6391, which describes the construction and operation of the Dorrco Mechanically-Cleaned Bar Screen.

415. Link Belt Company, 910 So. Michigan Ave., Chicago, Ill., shows in Book 642 its line of sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants.

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Sewer Cleaning Machines

416. Illustrated booklet describing Adjustable Turbine Sewer Cleaners, Self-Propelling Ferret Turbines, Drag Type Sewer Cleaners, Five Types of Sewer Rods, Conduit Rods, Windlasses, Sewer Braces, Sewer Cables, Turbine Sewer Machine Co., 5210 W. State St., Milwaukee, Wisc.

417. Turbine Sewer Machine Co., Inc., 5210 W. State St., Milwaukee, Wisc., has issued a 16-page *Price and Shipping Data Sheet No. A-31*. These sheets give a wealth of supplementary information to that found in our Standard Catalog or Bulletin 120-A. The Price and Data Sheets with or without catalog sent upon request.

418. "The Expanding Root Cutter and Sewer Cleaning Method" is the title of a recent 32 page booklet prepared by the Expanding Sewer Machine Co., Nappanee, Ind. Profusely illustrated, it gives full details as to methods and equipment needed.

Sludge Bed Glass Covers

420. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds.

Storm Sewers

423. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data regarding the use of Toncan Copper Molybdenum Culverts for economical and lasting storm sewers, drainage information, etc., will be gladly sent free upon request. Address: Toncan Culvert Mfrs. Assn., Massillon, Ohio.

424. A 24-page catalog, profusely illustrated with actual installations under widely varying conditions, which lists the features that give superiority to flexible corrugated metal construction for storm sewer installations, can be obtained from Armco Culvert Mfrs. Association, Middletown, Ohio. As for the catalog No. 5.

Treatment

425. Dorr Company, 247 Park Ave., New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

426. A new 48 page catalog dealing with Downes Floating Covers and Sludge Digestion Equipment has just been issued by the Pacific Flush Tank Co., 136 Liberty St., New York, N. Y. Catalog is very complete and includes interesting photographs of installations of floating covers and technical data on the subject.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. These are of real value to the designer or operator of a treatment plant.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the treatment of sewage with Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

432. The Dorr Company, 247 Park Ave., N. Y. C., publishes Bulletin No. 6491, which describes the construction and operation of the Dorr Detritor for continuously removing and washing the grit from sewage flows.

434. Automatic, continuous vacuum filters, producing a relatively dry cake of sludge in demand for fertilizer, are used by: Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C., write for literature, Oliver United Filters, Inc., Federal Reserve Bank Bldg., San Francisco, Calif.

Water Works Equipment

Activation and Aeration

465. A new booklet describing Norton Porous Mediums of bonded fused alumina (strong, chemically stable, uniformly permeable), the booklet will be of interest to all chemical and sanitary engineers. Issued by Norton Co., Worcester, Mass.

Couplings and Tees

485. A new booklet just issued by Mueller Company, Decatur, Ill., fully de-

scribes and illustrates the new line of Mueller Tapping Sleeves, Valves and Drilling Machines for water works officials.

505. "Mathews" Fire Hydrants. Gate Valves and other water works appurtenances. 16 pages, 7 1/4 x 10 1/4. R. D. Wood & Co., Philadelphia.

Joining Materials

515. MINERALEAD for bell and spigot water mains, G-K Compound for vitrified clay sewers, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Co., Mertztown, Pa.

Meters

520. "Niagara and American Water Meters are described in the 36-page catalog issued by Buffalo Meter Co., 2920 Main St., Buffalo, N. Y. Catalog describes the chromium-shell gear train, patented frost bottom, ultra-simple design and other exclusive features."

Meter Boxes

526. An illustrated catalog covering meter boxes and specialties such as gate valve housing, curb boxes, meter testers, melting furnaces, jointing materials, four-in-one pumps, has recently been published by the Hydraulic Equipment Co., Reading, Pa.

Pipe, Cast Iron

534. "Sand-Spun." Centrifugal cast iron pipe manufactured by R. D. Wood & Co., Philadelphia, is fully described in a valuable 16-page 6x9 booklet, containing also complete specifications of this pipe. No engineer or water works official should be without this booklet.

535. Cast Iron Pipe and Fittings, sizes 1 1/4 through 12 inches, either with or without Precast lead joints factory-made in the bells. Data book sent free. The McWane Cast Iron Pipe Co., Birmingham, Ala. and Provo, Utah.

536. "Weights and dimensions of Cast Iron Pipe and Fittings." A handy reference book for Municipalities and Contractors. 48 pages, 7 1/4 x 10 1/4. R. D. Wood & Co., Philadelphia.

539. U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe for Subdrainage

549. The benefits following the use of Armco perforated iron pipe for various municipal uses such as golf course, athletic field, and airport drainage; and its various applications in the construction and maintenance of highways and railroads are outlined in the 24-page illustrated catalog entitled, "Armco Perforated Iron Pipe." Catalog No. 4 is obtainable upon request from Armco Culvert Mfrs. Association, Middletown, Ohio.

Pumps, Waterworks

560. Centrifugal pumps for high or low service pumping for waterworks and filtration plants. Bulletins contain interesting installation photos, characteristic curves, etc. Dayton-Dowd Co. Mfrs. Centrifugal Pumps, Quincy, Ill.

561. Double suction centrifugal pumps are described in Bulletin 197; multi-stage centrifugals in Bulletin 200; deep well turbines in Bulletin 211, and a number of municipal pump installations in Bulletin 178. These contain much valuable data. Free on request. The American Well Works, Aurora, Ill.

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives recommendations of models for standby services for all power requirements.

Screens

576. Link-Belt Co., Chicago, Ill., has issued Book No. 1252, which describes their Water Screens and gives complete technical information about them.

Storage

579. "Modern Water Storage" is the title of a new booklet just issued by the Pittsburgh-Des Moines Steel Co., 3454 Neville Island, Pittsburgh, Pa. It contains 28 pages of reliable information, interesting photographs, authentic engineering data and "Pittsburgh-Des Moines" specifications on various types of elevated tanks, penstocks, pipe lines, stand pipes, steel reservoirs, treating plants and complete water systems. Copies free on request.

Tanks and Stand Pipes

582. A 50-page booklet issued by Pittsburgh-Des Moines Steel Co., 3479 Neville Island, Pittsburgh, Pa., on complete wa-

ter works plants, elevated tanks, stand pipes and filtration plants built by them.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Valves

585. Catalog covering our line of Bronze and Iron Valves for service on Steam, Water, Gas, Gasoline, Air and Oil lines furnished upon request. Also data on "Dart" Unions and Fittings. The Fairbanks Company, 393 Lafayette Street, New York, N. Y.

Miscellaneous

Airport Construction

595. Airports and Airways. A 20-page illustrated booklet by the Caterpillar Tractor Co., Peoria, Ill., describes the uses of tractors in building airports and handling planes.

597. "Getting on the Air Map With 'Caterpillar,'" profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Ill.

Airport Drainage

599. The Toncan Culvert handbook, containing 56 pages of typical Toncan Culvert installations and much valuable data pertaining to the use of Toncan Perforated Iron Drains and Culverts for economical and permanent drainage of landing fields, will be sent free upon request. Address: Toncan Culvert Mfrs. Assn., Massillon, Ohio.

Chains and Speed Reducers

607. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., gives full description of its positive drives in books. No. 125, Silent Chain; No. 1257, Roller Chain; No. 815, Herringbone Speed Reducers; No. 1050, Promal Chains. Send for these positive power transmission books.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Flexible Joints

611. Bulletin 204 containing 60 illustrations gives complete data regarding uses and specifications of Barco flexible joints for water works, sewage disposal plants, road contractors pipe lines, etc. Just issued by the Barco Mfg. Co., 1800 Winnemac Ave., Chicago, Ill.

Diesel Tractors

612. A new pamphlet just issued by the Caterpillar Tractor Co., Peoria, Ill., describes the "Caterpillar" Diesel 60 Tractor. Gives full details regarding dimensions and specifications.

Municipal Drainage Products

618. Pipe Lines and the Caterpillar. In this 32-page booklet are pictured many uses of the Caterpillar Tractor, and ways in which they can be applied to the saving of men, money and minutes. The Caterpillar Tractor Co., Peoria, Ill.

620. A complete line of drainage products which meets the modern municipal need for drainage materials that are quickly installed, safe, and dependable and economical in service is described in the new 24-page, illustrated catalog, "Armco Municipal Drainage Products." A request to Armco Culvert Mfrs. Association, Middletown, Ohio, for Catalog No. 9 will bring you this book free of obligation.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules. General Catalog No. 11.

Transits and Levels

630. A complete line of Transits and Levels particularly adapted for City, County and State work is fully described and illustrated in a new 64 page catalog just published by the Warren-Knight Co., 136 No. 12th St., Philadelphia, Pa.

PUBLIC WORKS

An Engineering and Construction Journal

City

County

State

VOL. 62

NOVEMBER, 1931

NO. 11

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Jerry and Mike & Ike:

Jerry Kavanagh of Chattanooga, Tenn., desists from writing about his new daughter, Patsy, long enough to send this one in: "The combined ages of Mike and Ike amount to 100 years. Mike is now 1.25 times as old as Ike was when Mike was 10 years older than Ike is now." A 2-year "sub" with all the trimmings to the first correct and properly worked out reply; and 1-year "subs" to the next three to come in under the wire.

Bull Run; Or the Horrors of War:

On page 32 Jack Hinman tells of some of his experiences in the "Third Battle of Bull Run." The worst of it he hasn't told, though. The call to arms came at 12:15 A. M., and he departed for the front at 6 A. M. Being already a state employee, Jack not only didn't get any pay, but he returned to find his pet bank out of business. Talk about the horrors of war!

Unemployment Relief:

Considerable space is devoted in this issue to methods of unemployment relief. Many engineers have found ways of turning this problem to the advantage of their municipalities by focusing the attention of municipal officials upon the needs for permanent improvements in the community. People are always willing to spend money for needed betterments, and the present time affords an opportunity to get these betterments for a relatively small expenditure, while providing also for the relief of people in need of employment.

Welcome:

"Birmingham's Health" is the title of a monthly publication, the first copy of which has reached this desk. It is issued by the Jefferson County (Ala.) Board of Health. Under the able and inspiring leadership of the health officer, Dr. J. D. Dowling, K. W. Grimley, M.S., C. E., is doing his usual fine job in putting out this journal.

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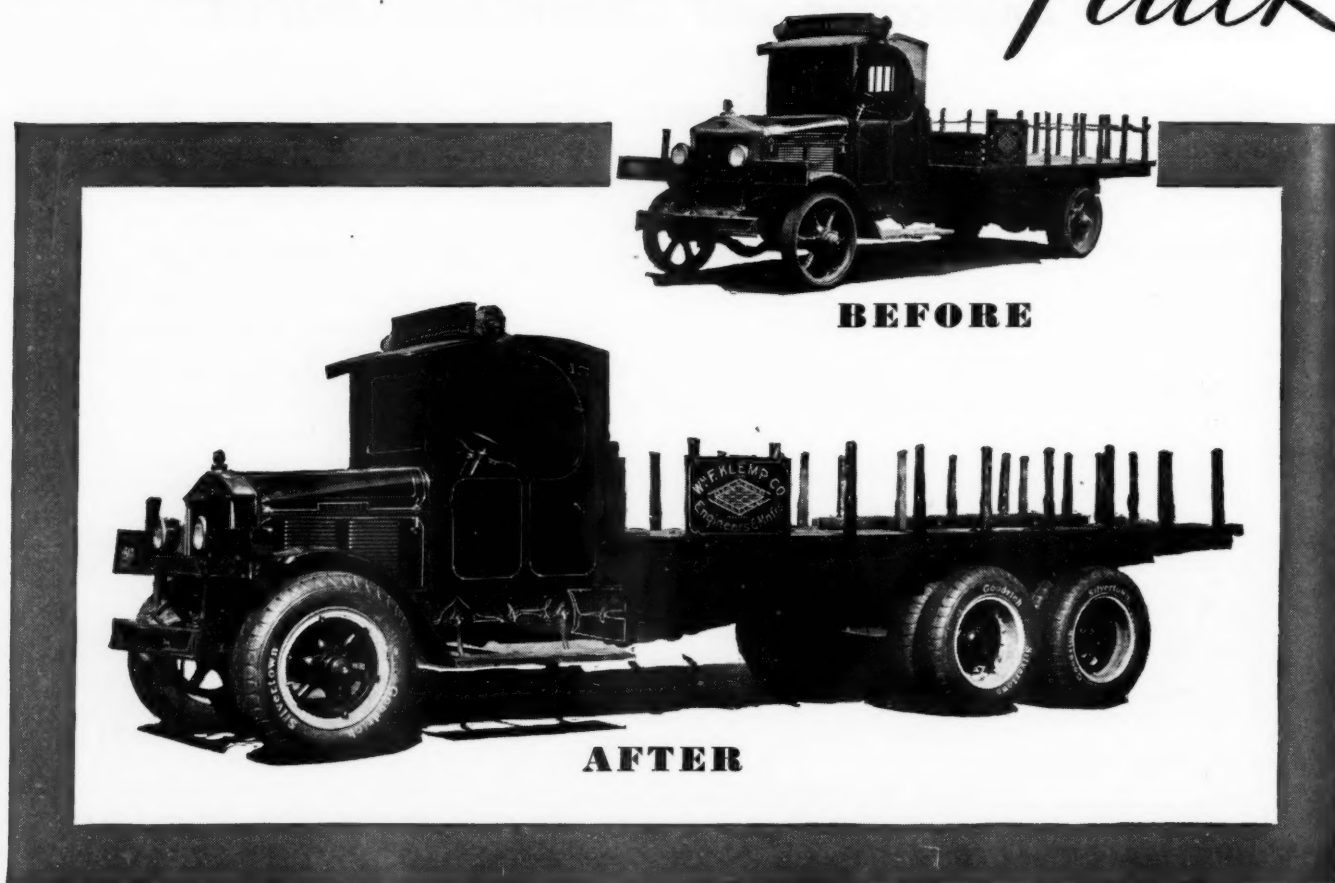
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PUBLIC WORKS

CITY

COUNTY

STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 62

November, 1931

No. 11

Casting yard. Each row represents one day's casting. Note white lines inside pipes between liners caused by whitewash on sheet metal forms to prevent sticking of asphalt.



60-Inch Clay Lined Concrete Sewer

By P. L. Brockway
City Engineer, Wichita, Kans.

COMPLYING with the requirements of the State Board of Health, the City of Wichita, Kansas, is constructing a treating plant for its sanitary sewage. The plant itself has no novel features. It will include bar screens, mechanical detritors, preliminary aeration, settling tanks with separate digestion of sludge, gas collection to be used principally in heating water for circulation in the digestion tanks and sludge drying beds. Provision is made for future aeration of the effluent, adding those units and a small preliminary settling tank using the present settling tanks for final settlement.

The sewer systems are separate with the exception that considerable roof water and a few isolated street drainage inlets are connected with the sanitary sewers. There are three separate outfalls in the systems as shown on the outline map. The districts served are sharply defined by the Arkansas River cutting off the west part of the city and the Drainage Canal segregating the drainage of the east portion. The

obvious location of the plant is near the outlet of the sewer serving the central portion. This site is half a mile from the nearest highway; more than that distance from the nearest house; bounded by the river on the south and the canal zone on the east; immediately adjacent to the Santa Fe railway and on ground which had been acquired at various times by the City in connection with the development of the canal and the old sewer outlets.

It was necessary to build an intercept about 10,000 feet long to reach the west side sewer, another 1,000 feet long to the east side and a larger main 6,200 feet long from the junction of the west side intercept with the old central systems. It was found possible to obtain a grade of 5 feet in 10,000 in the entire distance and intercept all of the old lines with gravity flow, placing siphons at the stream crossings with overflow weirs for emergencies and conditions of extreme dilution by excessive storm water.

The east portion of the city is purely residential

and, because of the absence of railroads and the influence of a well established zoning ordinance, reasonably sure to continue residential only. The existing outfall is reinforced concrete constructed in 1912. It is well ventilated through every connection to each house. Each connection is not trapped, having free circulation through the roof vent. There is always a perceptible flow of air downstream being drawn down through the stacks. The weir and intercept will not interfere with the flow of air through the old outfall. The concrete in the sewer is in excellent condition. For this reason the intercept to this line was designed of the same type, reinforced concrete, as a matter of economical construction.

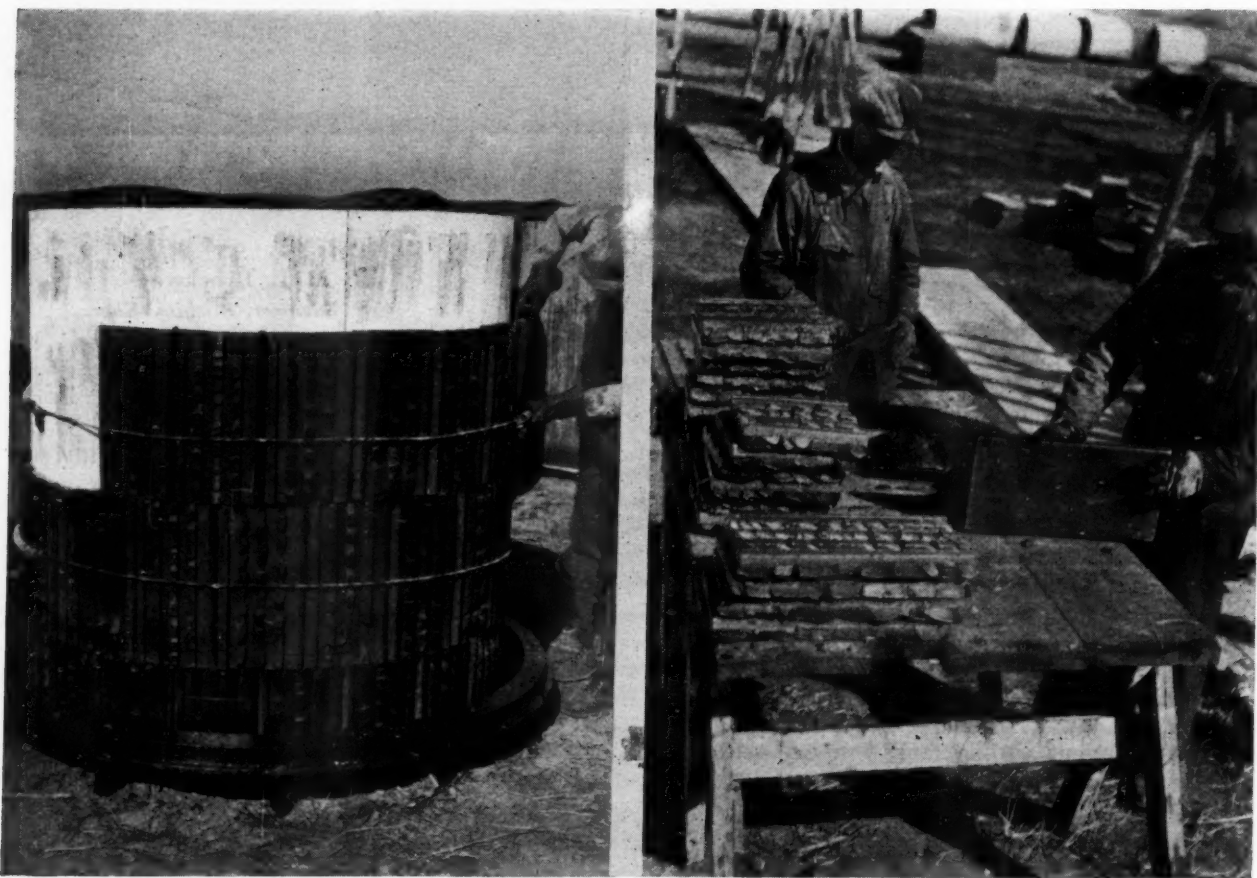
The other two mains serve territories which are partly industrial. The west side is served by two vitrified clay mains on very flat grades, the older one 30 inches, the more recent one 24 inches at a lower elevation.

The central part of the city is also served by two outfalls. The older one is brick, 36 inches in diameter. The bricks are very soft and porous. The mortar was apparently made with good portland cement. We have no reason to doubt that the construction was excellent. The actual grades and elevations of the entire system of about two hundred miles built in 1888 and 1889 agree remarkably well with the construction records which were made. The system lies well above ground water in sand which is fairly coarse. This is especially true of the outfall itself. The mortar joints have long since been changed to

soft putty-like consistency so that the sewer has no structural strength whatever. The exfiltration is very considerable. This unusual condition made it possible to connect an additional main outfall sewer, forty-two inches in diameter, into it about seven thousand feet above the outlet in 1919 and continue to use the old outlet for both of them until the present time. The 42-inch line normally runs half to two-thirds full and the 36-inch line also runs more than half full above the junction. However, it has served quite satisfactorily until the 42-inch line is now entirely paid for and the new joint outfall 60 inches in diameter is provided for both the central and western part of the city.

The 42-inch line was made of reinforced concrete. It carries, and must continue to carry concentrated industrial wastes of various kinds. It is also on less than one tenth of one percent grade, poorly ventilated along its length, and at the submerged junction with the old sewer. This condition also produces very slow velocity. It had only been in use a short time until hydrogen sulphide gas very seriously attacked the upper or exposed half of the sewer. A short section was cleaned by sandblasting and gunite placed. This was frankly experimental. The next year extensive floods entered the main at both ends, flowing first one direction and then the other, scouring off the plastic sulphates and depositing a coating of oily slime from adjacent oil refinery grounds. This slime, slightly improved ventilation, dilution from other industries

(Continued on page 60)



Left: Placing the liners. Bottom row wired. Upper rows held by temporary rope tightened by coil spring. Right: Applying asphalt mastic to the liner plates.

Striking off concrete prior to placing fabric reinforcing. Strike-off template being pulled forward by means of cables attached to framework of finishing machine and passing through pulleys anchored to subgrade template attached to mixer.



Reinforcement in Concrete Pavements and Bases

By James S. Burch

Research Engineer, Wire Reinforcement Institute

Condensed from a paper before the American Society of Municipal Engineers

IN this discussion of the design of reinforcement, no distinction is made between concrete pavements and concrete bases. While it is true that the presence of a wearing surface offers certain beneficial qualities in pavement service, the fundamentals of structural design are the same in the concrete base as in the finished concrete pavement.

In designing a roadway slab it is impractical to treat it as a floor slab in a structure. The points of support are unknown and of various intervals; and unless they are assumed as very close together, neither the practicable amount of reinforcing nor the compressive strength of the concrete would permit designing the slab to carry the wheel load of a heavy truck as a multiple-span self-supporting beam. There are, however, special locations where this may be done, as at bridge approaches, over trenches and at other places where points of very weak subgrade support exist adjacent to known points of strong support.

For general paving, however, it is more logical to assume a subgrade which furnishes fairly uniform support, to design the slab of proper thickness and strength to resist normal load stresses, and insure the integrity and service of the slab by reinforcing the section only with enough steel to resist the opening of any cracks which may develop. Briefly, the function of pavement reinforcing is to resist the formation of cracks caused by shrinkage and contraction, and to resist the opening of fissures or cracks which occur due to any cause whatever.

Causes of Cracking

The causes of cracking in concrete pavement slabs and bases may be grouped as follows:

1. Shrinkage of concrete during the setting period.
2. Later contraction due to temperature and moisture changes in the concrete.
3. Rupture due to traffic loads.
4. Bending stress set up by extreme non-uniformity of subgrade support or frost heaving, with or without the combined effect of traffic loads.

Shrinkage of Concrete During the Setting Period. Concrete in setting tends to shrink slightly. If poured on a smooth surface, like greased glass, the entire area would shrink in size; but if on a rough surface, like a subgrade, this is impossible and tensile stresses are caused by the effort to shrink, and cracks and fissures result. The number and width of cracks so formed depend upon the amount of subgrade friction, length of slab, tensile strength of the concrete at the time, and the extent of the influence which causes the tendency to shrink. It appears from investigations that almost all cracking which becomes visible later, occurs at fissures previously caused by shrinkage during the early setting period.

Research has shown that well-distributed reinforcing with small members closely spaced resists and retards the formation of shrinkage cracks and serves to very appreciably reduce the number and length of such eye-visible cracks.

Later Contraction. After the concrete has set it tends to change in volume at times because of changes in temperature and moisture content. Tendency to contract due to falling temperature or lessened moisture content is resisted by friction of slab on subgrade, the intensity of the resistance depending on the weight of the slab and the unit subgrade resistance, or "coefficient of subgrade friction," and the degree of



Reinforcing sheets in place after making strike off. Top concrete has been deposited in the rear and finishing machine is screeding final surface.

the contracting tendency. The magnitude of the stress in any one transverse section is equal to the force necessary to drag over the subgrade the length of slab between this section and the next free joint or crack. Therefore a crack will form at the distance from a free joint where this stress exceeds the tensile strength of the concrete. This distance usually lies between 15 and 40 feet.

Such a crack, once formed, creates two slabs which tend to contract toward their respective centers. If they do so contract this widens the crack, breaking the bond between the two slabs and allowing dirt to enter and making this a point of decided structural weakness.

But if well distributed and properly designed reinforcing is imbedded in the slab, this will resist the opening of the crack and keep the two faces close together with their irregularities interlocked, which permits transfer of load from one side of the crack to the other, maintains an even surface, preventing shocks of impact, and safeguards the strength and integrity of the pavement as a whole.

Rupture Due to Traffic Loads. The relatively small amount of reinforcement used in pavement slabs is not enough to increase greatly the resistance of an uncracked slab to the heavy traffic load which it must carry. It has been shown by test, however, that wire mesh type reinforcing when used in amounts as small as $\frac{1}{8}$ to $\frac{1}{4}\%$ materially increased the ability of the concrete to extend under tension without the appearance of eye-visible cracks. Thus it apparently affords an additional factor of resistance against slight over-stress. A more important benefit, however, is the holding of the sides in intimate contact, as explained above, after such a crack has formed.

No matter how well designed and constructed a slab may be, there is every reason to believe that it will develop cracks from other causes if not from static loads; and if such a crack opens even slightly, traffic loads are supported at a free end and the resistance of the section is materially lessened, the destructive forces of traffic impact are felt and progressive breakage begins.

Bending Stresses may be set up by extreme non-uniformity of subgrade support or by frost heaving, with or without the combined effect of traffic loads. The former occurs over old trenches in city streets, on settling fills, local areas of poor drainage, a slab partly on old macadam and partly on new grade, and other situations.

If the distance between areas of strong support be sufficient, the traffic loads will cause load cracks in the slab, and may break it into a number of small slabs. But if the slab contains distributed reinforcing, the crack faces will be held in contact, the surface of the slab be kept even and impact stresses avoided, the slab being in a condition of "controlled flexibility."

Logical Basis of Design

The rational basis of design of reinforcing seems to be to proportion the steel to resist tensile stress set up by subgrade friction with the slab undergoing contraction. We can more nearly evaluate the stress set up by this cause, and experience has shown that if this basis of design is followed, sufficient steel will generally be used to resist the other undesirable effects heretofore enumerated.

On this basis, the steel in either direction is proportioned to drag one half the slab length between free joints against the resistance of subgrade friction. In computing the required amount of steel on this basis of design, it is customary to use the following formula, which is tentatively recommended by the committee on "Specifications for Portland Cement Concrete Pavements" of the American Society of Municipal Engineers:

$$A = \frac{1 w c}{2 f}$$

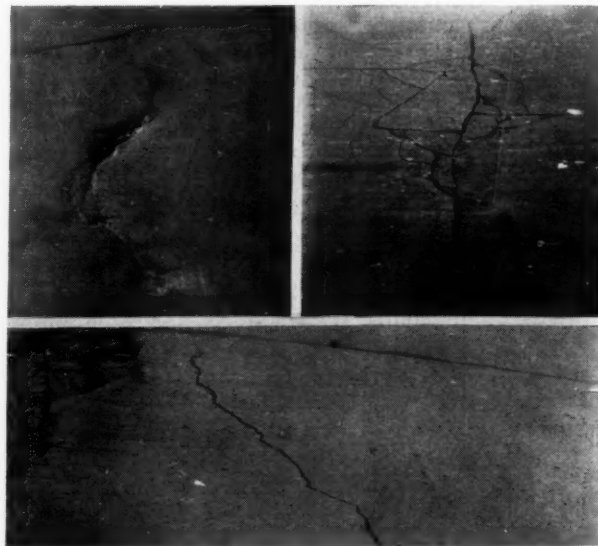
in which "A" is the effective cross-sectional area of steel in square inches per foot of length or width of section.

"1" is the length in feet (or the width, for transverse steel) of slab between joints across which no bonded steel is placed.

"w" is the weight of slab in pounds per square foot of surface area.

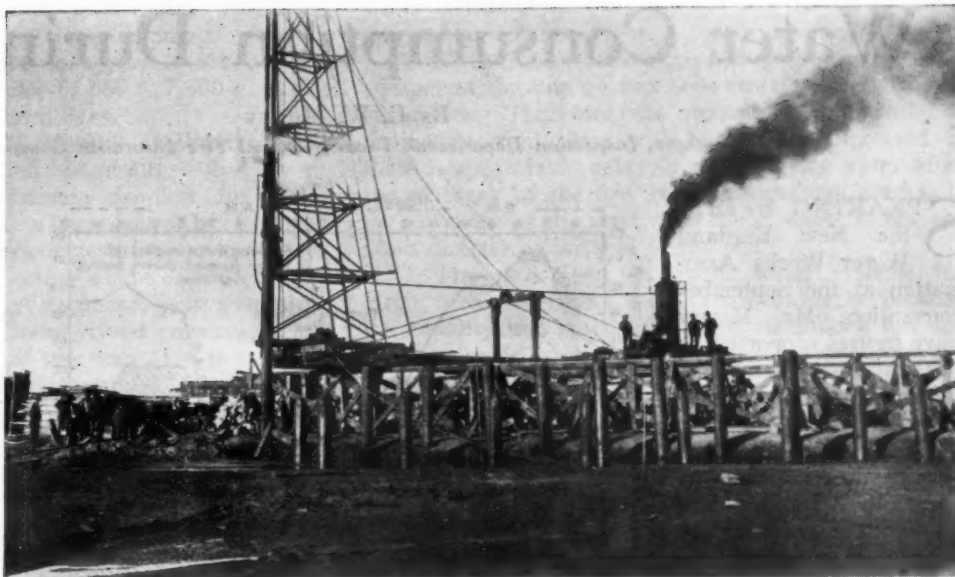
"f" is the allowable unit tensile stress in

(Continued on page 46)



Upper left—Depression in asphalt wearing surface over wide crack in unreinforced concrete base. Load transfer across this crack is impossible and progressive breakage probably will soon cause failure. Upper right—Cracking in asphalt surface caused by breakage in concrete base. Traffic has created numerous corners and progressive breakage to point of failure. Lower—Wide irregular crack in plain concrete under light traffic; apparently caused by shrinkage and widened by traffic and subgrade settlement.

Driving the piling,
using a Vulcan-Warrington
Steam hammer
mounted on a 60-foot
steel derrick.



A Composite Highway Bridge in New Mexico

In our issue for December, 1930, under the title "Designing a Composite Bridge," P. L. Brockway described a type of bridge built in Wichita, Kans., in which a floor of steel beams and concrete slabs was supported on timber pile bents. In the "New Mexico Highway Journal" M. D. Reynolds, Project Engineer for the New Mexico Highway Department, described a somewhat similar bridge. His description, in condensed form, is given below.

A BRIDGE carries West Central Avenue, Albuquerque, across the Rio Grande which consists of fifty-four 25 ft. spans of steel and concrete superstructure resting on creosoted pile and timber bents and abutments. Creosoted pile substructure was used because of limited funds, and the expectation that the river bottom will be lowered.

Each of the fifty-three bents contains six 60 ft. piles, with a cap of 12"x14" material 30 ft. long. Each bent is braced with 3x10 sway braces and 3x10 girts placed at low water elevation. Each of the two abutments contains eight 60 ft. piles lagged with 3x8 lagging, and 8x12 buck braces 4 ft. long are provided at each pile. Southern yellow pine creosoted 12 lb. to the cubic foot is used.

The superstructure consists of five lines of steel I-beam stringers supporting concrete roadway slabs and a concrete hand rail, and a sixth line of beams supporting the outer edge of the sidewalk. The roadway beams are 21-inch Carnegie I-beams, the center one weighing 70 lb. per foot, the next two 58 lb. and the two outer ones 55 lb. The sidewalk stringer is a 35 lb. 16-inch blocked up from the cap by two blocks at each bent.

The roadway slab is $8\frac{1}{4}$ in. thick, and the sidewalk slab $5\frac{1}{2}$ in. There is a transverse expansion joint over each bent and a longitudinal joint over the central I-beam, all made with premoulded bitu-

minous joint filler. A copper plate with a V trough pressed into it was placed at each transverse joint, two inches below the surface of the concrete, which drains surface water to one side.

At each end of each span is a concrete beam which ties the steel stringers together; the beam being $21\frac{3}{4}$ in. deep (including the $8\frac{1}{4}$ in. thickness of the slab) and 15 in. wide, reinforced with four $\frac{7}{8}$ in. round bars in the bottom and $\frac{1}{2}$ in. square stirrups; a 45° knee connecting the bottom of this with the bottom of each stringer $7\frac{1}{2}$ in. lower. The I-beams rested on bed plates which were fastened to the caps by two $\frac{3}{4}$ in. lag screws.

Provision for future lighting was made by placing conduit in the hand rail posts and inserts under the slab on both sides to which longitudinal conduit can be hung. Anchor bolts to fit a standard newell were placed in the posts so that there will be a light every 75 feet along the bridge.

The piles were driven by means of an overhanging driving rig—a 60 ft. steel derrick carrying a Vulcan-Warrington No. 3 steam hammer taking steam from a 16 h.p. boiler. After the piles of one bent had been driven they were cut to the correct elevation, the top coated with hot creosote oil and hot tar and covered with a piece of 26 gauge galvanized sheet iron and the cap put on. Then 2x6 ribbons were nailed

(Continued on page 71)

Water Consumption During Fires

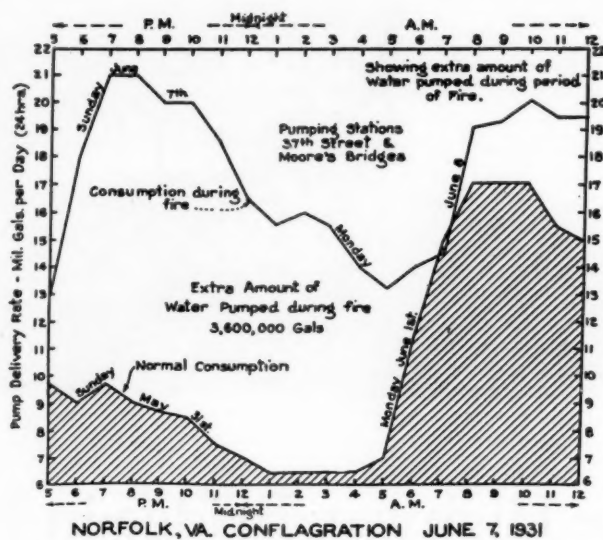
By C. W. Mowry

Manager, Inspection Department, Factory Mutual Fire Insurance Companies

SPEAKING before the New England Water Works Association at the September convention, Mr. Mowry gave figures supported by illustrations relative to the amount of water needed at fires.

He first called attention to the fact that the sooner the water could be applied, the less would be needed to extinguish the fire. A few gallons from automatic sprinklers released at once above the source of a fire would probably extinguish it, while several million gallons might be needed if the fire gain good head-way. Since these are not installed in every place where a fire may start (a disastrous fire at Nashua, N. H., in 1930 started in an old wood bridge, covered top and sides with wooden sheathing), or may be temporarily out of service (in a cotton mill at Dover, N. H., the sprinkler system was shut off temporarily to replace a sprinkler, and it required over eight million gallons of water to extinguish the fire), it is most important to provide sufficient water to fight any fire which the nature and size of the buildings in the city under consideration render possible.

"Although in the average city, only a fraction of one per cent of the annual water consumption is used for extinguishing fires, yet the rate of consumption during a large fire may be higher than the capacity



This fire occurred on Sunday, when normal consumption was low. On a week day the total consumption would have been about 8 m. g. d. greater.

of the system. This is especially true today when out-of-town pumpers can be so quickly concentrated."

In the Dover, N. H., fire referred to, it was estimated that there was used 5,500,000 gals. by fire pumps from the river, 800,000 gals. by fire engines from the river, and 1,900,000 gals. of city water, a total of 8,200,000 gals. in extinguishing the fire in this mill. The city water was shut off after 11 hours, as the reservoir had been drawn down dangerously low.

An armory in Buffalo, N. Y., was completely destroyed in May, 1931,

and the water department estimates that the maximum rate of water consumption used at the fire was 6,500 g. p. m. for three hours, and that in addition there was used, at other simultaneous fires within a mile of the armory, 2,660 g. p. m. for a period of 1½ hours, or a total rate of 9,210 g. p. m.

At another Buffalo fire in 1928 the quantity used was at the rate of 13,500 g. p. m. from the city mains, 6,000 from the high-pressure system, and 4,000 from fire tugs, a total of 23,500 g. p. m.

At the Nashua, N. H., fire referred to above the maximum draft was about 7,500 g. p. m., and about 5 million gallons of water was used in excess of normal consumption, one million from the reservoir

Water Consumption During Typical Sweeping City Fires and Conflagrations

Location Date and Approximate Fire Loss	Duration Fire Until Under Control (hours)	Extra Water Used During Fire (mil. gal.)	Peak Rate		Rec. Max. N. B. F. U. Standard (m.g.d.)	Max. Daily Domestic Rate (m.g.d.)	Total Pumping Capacity (m.g.d.)
			During Fire (Domestic & Fire) (m.g.d.)	Max. Fire Flow During Fire (m.g.d.)			
Norfolk, Va., June 7, 1931. \$1,250,000	6½	3.6	21.	12.	14.4	14.2	61.
Nashua, N. H., May 4, 1930. \$2,500,000	9	5.	10.8	9.	7.2	4.6	14.
Fall River, Mass., Feb. 2, 3, 1928. \$2,550,000	12	20.	31.	26.2	14.4	9.3	24.
Nashville, Tenn., March 22, 1916. \$1,500,000	4¾	..	17.5	6.5	14.4	17.3	Gravity from 47 mi. gal. res.
Salem, Mass., June 25, 26, 1914. \$8,000,000	13	16.	26.	22.	8.6	4.1	
Chelsea, Mass., April 12, 1908. \$12,000,000	7½	29.	23.	21.	7.2	Ave. Daily for high mo. 6.	10.0

Gravity from large res.

and the balance from a 6 m. g. d. pump, reinforced after three hours with an 8 m. g. d. pump.

"It is not at all unusual today," said Mr. Mowry, "to use 20 to 30 hose streams (5,000 to 7,500 g. p. m.) to fight 3-alarm and 4-alarm fires."

Quoting from the 1925 Manual of Water Works Practice of the A. W. W. A., page 301,—

"The duration of maximum fire-flow for which provision should be made is suggested by Freeman as six hours, and such basis of design is quite common in the smaller cities and towns where dependence for fire supply is placed in part upon storage in standpipes or elevated tanks. The Underwriters recommend five hours fire flow for towns of less than 2500 population, and ten hours for larger communities."

The generally accepted standard for the total quantity of water which should be available for fire service in the average city is that in the Standard Grading Schedule of the National Board of Fire Underwriters. Typical quantities according to this standard are as follows:

Population	Required Maximum Fire Flow g.p.m.	Population	Required Maximum Fire Flow g.p.m.
10,000	3,000	60,000	7,000
13,000	3,500	80,000	8,000
17,000	4,000	100,000	9,000
22,000	4,500	125,000	10,000
28,000	5,000	150,000	11,000
40,000	6,000	200,000	12,000

For cities of more than 200,000 population the fire flow should be 12,000 g. p. m. plus 2,000 to 8,000 g. p. m. additional for a second fire.

"The general principles that apply to the study of

Representative High-Pressure Fire-Systems

City	No. Pumps	Max. Pressure		Capacity	
		No.	lbs.	g.p.m.	m.g.d.
Atlantic City	9		150	12,000	17.3
Baltimore	3		210	12,700	18.3
Boston	4		200	19,000	27.4
			300	12,300	17.7
Buffalo	3		200	9,000	12.9
Cleveland	4		270	10,000	14.4
Detroit	6		300	15,000	21.6
Manhattan, N. Y.	12		300	36,000*	51.9
Brooklyn, N. Y.	8		300	26,400	38.
Coney Island (Now). .	3		150	4,500	6.5
(Under construction). .	5		225	13,500	19.5
Philadelphia	20		300	21,450	30.9
San Francisco	8		300	24,000	34.6
Winnepeg, Man.	3		300	10,800	15.5

* Heaviest draft ever made on system was in 1909 when five fires occurred at once. Seven of the pumps delivered 34,000 g.p.m. at 225 lb. average pressure.

Private Fire-Systems for Industrial Properties

Location	No. Pumps	Max. Pressure		Capacity	
		No.	lbs.	g.p.m.	m.g.d.
Lowell, Mass.					
Locks & Canals System					
Supplies 9 mills....	9		80	18,500	26.6
Also 2 mil. gal. reservoir furnishing 4000 g.p.m. at 60 lb. flowing press.					
Lawrence, Mass.					
Conn. 9 properties..	23		100	27,000	38.9
New Bedford, Mass.					
Conn. 4 properties..	12		100	14,000	20.2
Moline, Ill.					
Conn. 9 properties..	10		100	10,000	14.4
Gatineau, P. Q.					
One paper mill....	4		135	10,000	14.4
Three Rivers, P. Q.					
One paper mill....	4		100	8,000	11.5

water consumption during fires may be briefly summarized as follows:

"1. Most fires are extinguished promptly by hand equipment, by one or two hose streams, or by a few sprinklers. Therefore, the amount of water used is ordinarily small, but will be greatly increased if there is appreciable delay in applying the water after the outbreak of the fire, if the rate of application is not sufficient at the start, and if the water is not applied directly at the seat of the fire.

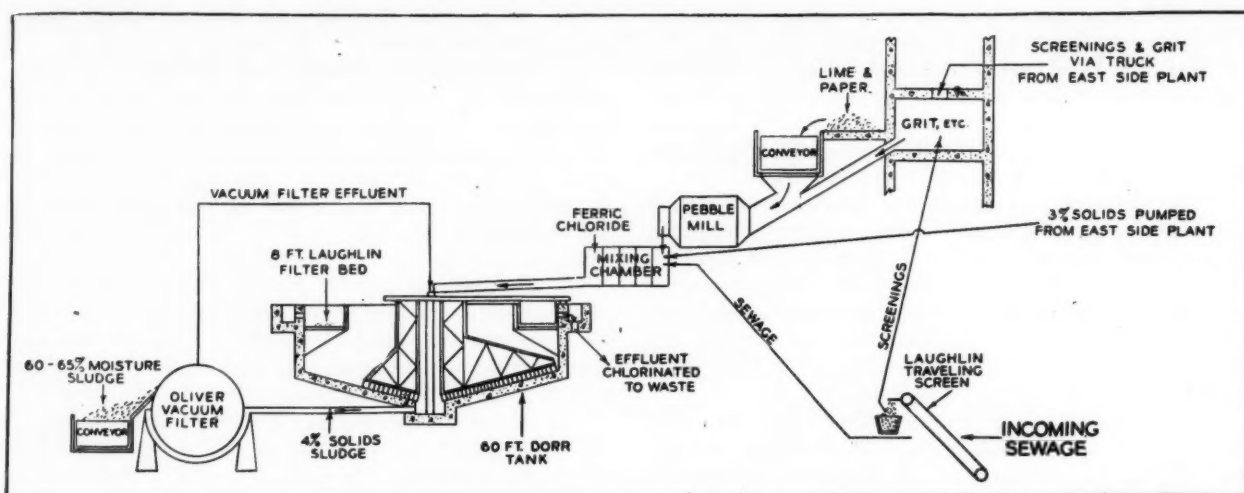
"2. The peak load on public water systems for large fires is greater today than formerly because the mobility and speed of modern automobile fire apparatus enable large pumping capacities to be quickly concentrated in any city where needed.

"3. Although the amount of water used annually for fire fighting in the average city is less than 1% of the total amount pumped, yet when a fire obtains a good start, the maximum rate of water consumption needed to control the fire and supply all other demands simultaneously may exceed the capacity of the regular water system.

"4. This possible sudden large demand is the reason why supplementary water supplies of large capacities are provided in the form of special high-pressure fire-systems for municipalities, and in the form of private fire pumps for individual properties of considerable value or hazard."



Below—Two lower stories and part of third saved. Four million used in first twelve hours and 8 million gallons in all. Above—Drowning a Baltimore fire with 75 tons of water



Flow sheet, new Dearborn sewage disposal plant.

New Sewage Treatment at Dearborn, Mich.

A SEWAGE treatment plant which will be the first operating plant of its kind and will rely entirely upon mechanical and chemical processes is under construction at Dearborn, Mich., and will, it is expected, be in operation by January 1st, 1932. The process was tried out in Dearborn in an experimental plant of about $\frac{1}{2}$ m.g.d. capacity built in 1930, of which a test was run continuing from Sept. 2nd to Nov. 22nd, by Hubbell, Hartgering & Roth, consulting engineers of Detroit.

In 1920 Dearborn had a population of 2,400. In 1928 it consolidated with the city of Fordson, the combined cities being called Dearborn. In 1930 the population was about 50,000. It lies adjacent to the city of Detroit, which in 1926 built an outlet sewer through the center of Dearborn to the River Rouge, which flows through the latter city; an agreement for a joint sewage treatment plant being entered into between the two cities, under which Dearborn was to finance, build, operate and maintain the plant, Detroit's prorated share of the cost of which was to be paid by that city.

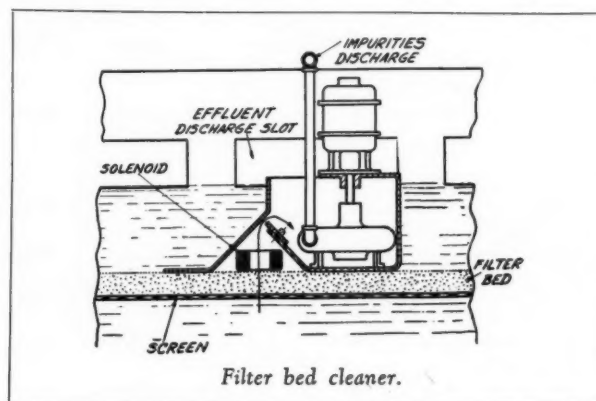
In 1924 the city of Fordson put into operation an Imhoff sewage treatment plant of 5 m.g.d. capacity, now called the East Side plant. The new plant now under construction is called the West Side plant and is designed to treat sewage from 12 square miles of Dearborn, and also to receive the sludge from the East Side plant (the Imhoff tanks being operated as plain sedimentation tanks) derived from a similar area, and sludge from the sewage of 33 square miles of Detroit territory. The sludge from the East Side plant is to be pumped, at a consistency of 3% solids, through an 8-inch pipe line to the new plant.

In the new plant, lime, ferric chloride and paper pulp are added to the sewage, which then passes through a baffled mixing chamber and into a circular Dorr clarifier. In leaving the clarifier the sewage flows upward through a filter located annularly around the inside of the clarifier tank (which filter is of a novel design, to be described in a following

paragraph) is chlorinated and discharged into the river. The sludge is pumped to Oliver vacuum filters, the sludge cake from which is delivered by belt conveyor to bins with hopper bottoms or to a storage pile; the effluent from these filters being returned to the clarifiers. The sludge from the East Side plant will be treated in the same manner in a duplicate mixing chamber and clarifier. It is expected that sludge of 10% solids will be delivered to the vacuum filters and that these will produce a cake of about 40% to 45% solids.

The entire plant is completely enclosed in one building. The walls of the entrance lobby, laboratory and motor room are of terra cotta, the floor of the motor room of terrazzo and those of the lobby and laboratory of tile.

Among the unusual features of the process and plant are the addition of paper, mixed with screenings and grit from a screen chamber at this plant and those caught at the West Side plant and brought from there by trucks; all of which are deposited in pebble mills from which they come out as a slurry, to be mixed with the sewage and West Side sludge, the grit serving as the grinding medium in the pebble mills. The paper used will be newspapers, car-



tons, etc., contained in the regular city refuse, which is sorted.

Most of the lime used will be in the form of sludge from a nearby Prestolite plant, the cost of which will be little beyond that of hauling. It and the paper will be deposited in bins, weighed in weighing scales and pushed onto a flight conveyor, which will deliver it to the pebble mills, where it will be mixed with settled sewage.

The ferric chloride used will be made at the plant in a Mathieson ferric chloride generator, from tin cans and bushings from the city salvage plant, combined with chlorine.

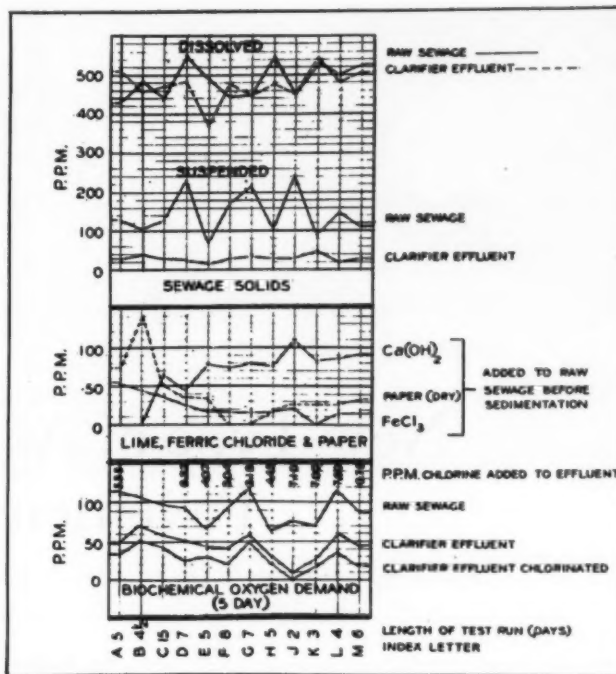
Each of the mixing chambers is 24 ft. 6 in. long, 4 ft. wide and 3 ft. deep, with steeply sloping sides and seven baffles, all made of $\frac{1}{4}$ -in. steel plate.

The Dorr clarifiers are 60 ft. diameter and are provided with Laughlin magnetite filters. Each filter is in the form of a channel 8 ft. wide around the inside of the clarifier tank, the bottom of the channel being a slotted screen of phosphor-bronze with openings 1 mm. wide, in which is placed a 3-in. layer of magnetite sand passing a 10-mesh and retained on a 16-mesh sieve. The clarified sewage passes upward through this sand. For cleaning the sand there is provided a traveller which carries a solenoid immersed in oil and encased in bronze, and a pump for removing the wash water from the carrier sump. The solenoid, as it rests temporarily over any part of the sand bed, raises the magnetite sand from the screen, whereupon the clarified sewage rushes up at this point and washes the sand, which is then dropped into place by the intermittent operation of the current and the solenoid advances a distance such that the washings overlap. The wash water flows into the traveller sump, from which a small centrifugal pump transfers it to the clarifier.

The specifications governing the operation of this filter provide that, with normal sewage containing from 150 to 250 parts per million suspended solids, when operating at a rate of two gallons per sq. ft. of screen area per minute, at least 80% of the suspended solids shall be removed, of which 80%, the Laughlin magnetic filter shall remove at least 8%, namely the amount from 72% to 80%; and when operating at a rate of one gallon per sq. ft. of screen area per minute, at least 87% of the suspended solids shall be removed, which 87% the filter shall remove at least 8% namely the amount from 79% to 87%.

The two Oliver filters are each 2 by 12 feet and are expected to reduce the moisture content to between 60 and 65%, in which reduction the paper pulp will aid greatly. Facilities are provided for delivering this sludge to the trucks of farmers or others. This process was developed by W. C. Laughlin, of the Filtration Equipment Corporation, and Mark B. Oliver, superintendent of public works and engineering, Dearborn.

It is believed that this plant will treat successfully a maximum flow of 6 m.g.d. The present flow from the West Side of Dearborn is estimated to be 2.75 m.g.d. The East Side plant is now treating 15 m.g.d., but it is believed that, with the sludge removed daily to the new plant and with changes in influent channels and weirs, this plant can treat a maximum of 40 m.g.d. At present all the sludge



Operation of test plant, Dearborn, Sept. 2 to Nov. 22. Sewage solids determined daily from composite sample B. O. D. determined from single catch samples usually collected between two and four p. m. each day (some days omitted).

from the East Side plant will be pumped and treated at the new plant during less than eight hours, so the capacity of this service can be increased three-fold by increasing the pumping time.

The contract cost for building, and complete pumping and other equipment is approximately \$455,000. The general contractor was the W. H. Mueller Co., of Detroit. Hubbell, Hartgering and Roth were the designers of the superstructure and pumping equipment and furnished plans for the Filtration Equipment Corporation, equipment engineers.

Previous Experimental Results

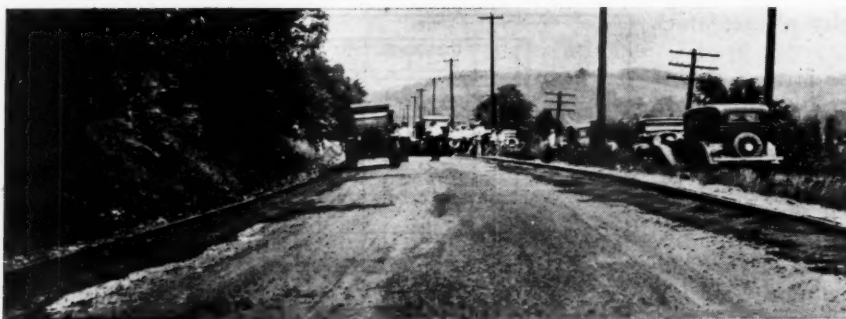
As stated, this process was tried out in an experimental plant last year. A wooden clarifier tank 30x12x12 ft. provided a detention period of $1\frac{1}{2}$ to 3 hours, two wooden tanks 5 pt. square and 8 ft. high were used as mixing tanks for chemicals and paper, and a Paradon Chlorinator and small rotary vacuum filter were installed. The sewage treated was about 1% of the dry-weather flow from 146,000 people, containing normally from 60 to 22 p.p.m. of suspended solids and 430 to 550 p.p.m. dissolved solids.

The process tried was practically that used in the plant now under construction. About 600 lbs. of lime, 200 lbs. of ferric chloride and 300 lbs. of paper as pulp were added to, and mixed with, the incoming raw sewage.

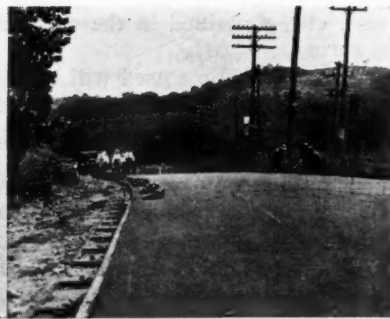
Solids settled in the clarifier were withdrawn as a sludge containing about 97% water and delivered to a rotary vacuum filter where the moisture content was reduced to as low as 60%. In this condition no odor was present and no appreciable deterioration sets in within at least a year.

Samples of raw sewage and treated sewage were collected hourly, composited for 24 hours, and regular standard analyses made.

(Continued on page 54)



Forms in place. Patching and leveling up base course preparatory to placing T-5 surface



Removing steel forms

New Type of Asphaltic Concrete Pavement in Ohio

Plant mix similar to sheet asphalt laid with the aid of finishing machines before rolling.

By Earl V. Murray

Ohio State Highway Department, Columbus, O.

OHIO'S state highway department is this year laying for the first time, a new type of hot-mix surface course known to highway engineers and highway contractors as "T-5." To those not familiar with this designation, it may be explained that this type is a sequel to bituminous concrete, except that a slightly coarser mineral aggregate is used, producing a surface of non-skid features. It is hot mixed similar to sheet asphalt material, and rolled in the same manner; but instead of the usual raking and shoveling, a finishing machine is used to level and smooth the loose surface mixture to proper grade or cross section before rolling commences.

Although a number of miles of T-5 pavement have been placed under contract this season by the state department of highways, but two of these jobs have been completed to date. However, the practicability of using a finishing machine for the laying of this type has been demonstrated and the results obtained on the finished pavements prove out the judgment of the engineers that a coarse hot-mix pavement has a place on the state's system of highways.

State route No. 16, the Newark-Coshocton road, commencing at Newark, Ohio, and extending east for 5½ miles, was the scene of the first T-5 pavement to be laid by the state. The Federal Asphalt Paving Company, of Hamilton, Ohio, were the contractors.

The design of this improvement provided for the salvaging of the narrow existing macadam pavement. Two feet of waterbound macadam base course was laid alongside the old macadam and a new T-5 surface course covering all, a total width of 20 feet.

Not only was this project unique from the standpoint of using the new pavement,—it was the first successful attempt (in Ohio at least) at using a finishing machine for hot-mix material. While construction was in progress traffic was permitted to use one side while the other half was being built, thus eliminating the inconvenience to traffic in taking a detour; except that it was necessary at one point on this improvement to detour traffic for a short time only.

The other project using T-5 was that awarded February 24, 1931, by state highway director O. W. Merrell, to the Robinson, Burns & Cooper Company, Columbus, Ohio, which called for grading, construction of drainage structures and widening and resurfacing 3½ miles of U. S. No. 20, the Cleveland-Buffalo road, east of North Kingsville, in Ashtabula County, Ohio. Incidentally, this route is the heaviest traveled in the state of Ohio and the specifications called for the construction to progress without detouring traffic from the highway.

Like the other T-5 project, the design contemplated the use of the old pavement. Two 11-foot



U. S. No. 20 being reconstructed. New 11-foot concrete slab finished on each side and T-5 bituminous concrete being placed on old brick pavement.

width concrete slabs were laid alongside of the old existing 18 foot pavement, and T-5 surface placed over the old pavement, between the concrete slabs, making over all a 40-foot pavement from edge to edge.

So far, T-5 pavements have been used on reconstruction work where widening was necessary. In this method Ohio's highway engineers are effecting a considerable saving of public funds for, first, it saves the expense of a new base course and, second, conserves that base by covering same with a hot-mix asphaltic concrete surface, impervious to water and providing a pavement capable of meeting the demands of heavy traffic and at the same time building in that pavement a non-skid feature.

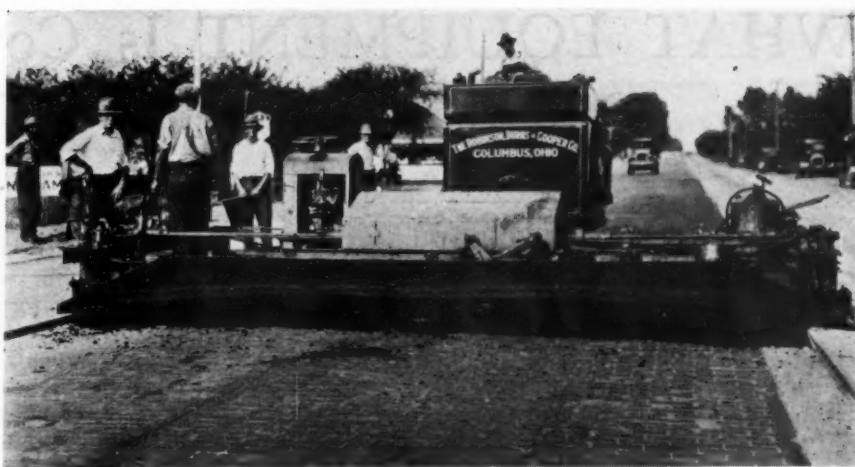
This wearing course is composed of a compacted scientific mixture of mineral aggregate and bituminous material, laid usually in two courses upon an accepted base in accordance with plans and specifications. Incorporated in this mixture is asphalt cement of a required penetration; sand which is clean, hard and durable of a specified size; and a carefully graded stone of variable sizes.

The mineral aggregate which is to be used is placed in a mixing plant and heated to a temperature of from 250° to 350° F. Mechanically handled, the stone (aggregate) is heated and dried in a rotary drier and while still hot is passed through a rotary screen, each size stone is placed in a separate bin or compartment. From these bins the desired amount of each size of stone is drawn into a weight box, which accurately and separately weighs each. The

batch is then dumped into a "Twinpug" mixer, where the aggregate is thoroughly mixed with the asphalt cement, the latter ingredient being heated separately prior to coming into contact with the stone and sand, until every particle is covered with asphaltic cement. It is required that the temperature of this mixture be not less than 250° when delivered to the job, at which temperature it is sufficiently plastic to permit of raking and rolling to proper compaction.

The movement of trucks is so regulated that the loads, as they arrive, can immediately be dumped in even piles before the finishing machine.

While some hand labor is required in the laying of this type, the majority of the work is performed by machinery. Laborers rake and spread the dumped surface mixture to a uniform thickness before the finishing machine, which in turn transforms the loose material to a smooth, level course ready for the final operation of rolling, which is performed with a ten-ton tandem roller.

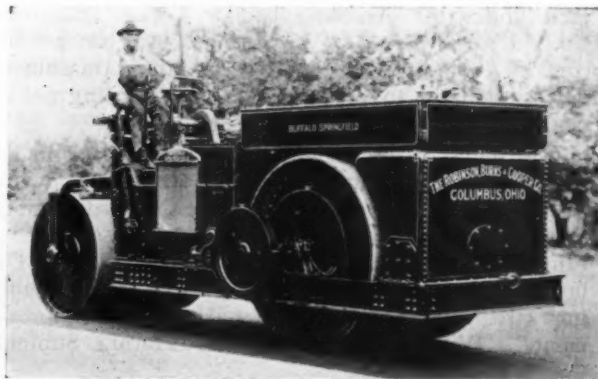


Finishing machine worked 1800 sq. yd. daily of hot mix on U. S. No. 20.

Right—Finished reconstruction project, with T-5 laid on old pavement with 11-foot concrete slabs on each side.

Left below—Portable asphalt plant of Robinson, Burns & Cooper used in U. S. No. 20.

Right below—New type 10-ton tandem roller used on U. S. No. 20.



WHAT EQUIPMENT Is Covered by the CONTRACTOR'S BOND?

By John Simpson

Rental of Equipment

THERE is much conflict of opinion as to whether the rental of a public works contractor's equipment used in the prosecution of the work is covered by the contractor's bond. Jurisdictions holding that it is not covered are: Iowa, Louisiana, Maryland, Nebraska, Oklahoma, Ohio, Wisconsin.

In other jurisdictions, however, the statutes requiring such bonds have been held broad enough to cover the rental of the contractor's equipment. It is so held in Alabama, Arkansas, California, Kansas, Minnesota, Oregon, South Dakota, Washington. This is the rule in the federal courts under the federal statute, since the decision of the United States Supreme Court in *Illinois Surety Co. vs. John Davis Co.* (1917) 244 U. S. 376.

Payments for rental or use of equipment hired by a road contractor are within the provisions of a highway construction contract bond covering claims for materials, supplies, tools, appliances and labor incurred in carrying out the provisions of the contract which might fairly be held to have been in contemplation of the parties. *Western Material Co. vs. Emke* (S. Dak.) 228 N. W. 385.

Rental of a construction outfit, consisting of pile driver, cement mixer, tents and tools, and for loss of a mule rented by a bridge contractor were not within the statutory bond. *Colonial Creosoting Co. vs. Perry*, 169 La. 90, 124 So. 182.

The rental for a concrete mixer used in constructing a street improvement and its moving were not within the term "material and labor," since the mixer was to be classed as "appliances" or "equipment," although an operator for the mixer was furnished, and claim therefore did not support a lien under the Ohio Mechanics' Lien Law. *Cincinnati Quarries Co. vs. Hess*, 28 Ohio App. 340, 162 N. E. 686, following *Royal Indemnity Co. vs. Day & Maddock Co.*, 114 Ohio St. 58, 150 N. E. 426, where it was held that the rental of a concrete mixer, hoisting engine or other machinery used as appliances or part of the equipment was not covered by a contractor's bond.

Rentals of a road contractor's equipment used in the construction of a highway bridge were held covered under the Alabama bond. *Union Indemnity Co. vs. State*, 217 Ala. 35, 114 So. 415, but not the cost of extraordinary repairs of rented machinery necessitated by an accident to a hoisting engine, *ib.*

Rental of Stock

The rental value of mules and horses used in the construction of a municipal reservoir was held covered by a bond given pursuant to the California Public Works Act, without deduction for nonuser due to rain or unfavorable conditions. The court said: "Delays due to the weather were a part of the surrounding circumstances which entered into the improvement." *Williamson vs. Egan*, California Supreme Court, 287 Pac. 503.

The Louisiana Act No. 224 of 1918, governing contracts for public works and contractors' bonds does not cover bills for teams of mules rented to a subcontractor, but it does cover the amount due under a contract by which a subcontractor agreed to pay \$7.50 per day for each team and a driver used in the excavation work in connection with the construction of a water and light plant. The court construed the contract as one to do work, and so covered by the bond. *Childers vs. City of Monroe* (La. App.) 122 So. 135.

But claims for hiring of teams were held not recoverable because not for material which became incorporated as part of the highway. *Long Bell Lumber Co., vs. S. D. Carr Const. Co.* (La.) 133 So. 438.

A bond was held to cover the amount due by a road contractor for the use of mule teams, where it was a condition of the bond that the surety should "pay all bills for material and labor entering into the construction of said work or used in the course of the performance of the work," following the language of the Harrelson Road Law, which, it was held, was not expressly repealed by Acts 1927, No. 11, p. 23. The court distinguished *Goode vs. Aetna Casualty & Surety Co.* (Ark.) 13 S. W. (2d) 6. Three judges dissented. *Terry vs. Little* (Ark.) 18 S. W. (2d) 916.

Lumber Used in Construction

Lumber used for forms, sheathing and shoring in connection with the construction of the sewer, used up and destroyed in the performance of the work, was held not covered. *City of Philadelphia vs. Perna Engineering & Construction Co.*, 94 Pa. Sup. Ct. 579.

Lumber supplied to and used by a bridge contractor to make forms to hold concrete, which, when the concrete had set, were torn down and remained the property of the contractor was held not covered by a bond insuring payment for materials forming part of the finished structure or capable of being so used, as prescribed by the Ohio statute. *Indemnity Ins. Co. vs. Portsmouth Ice, etc. Material Co.* (Ohio App.) 172 N. E. 566.

Steel sheet piling furnished and used in the construction of a bridge, to sink piers in the middle of the river, which piling formed a part of the permanent bridge structure, were held within the contractor's bond.

Lumber used in the construction of the bridge, and labor performed on the bridge by laborers paid by the claimant, and from whom the claimant received an assignment and subrogation, were within the bond. *Colonial Creosoting Co., vs. Perry*, 169 La., 90, 124 So. 182.

Claims for piling and sway braces used for scaffolding
(Continued on page 70)

The Longest Bridge Span in the World

By Frank W. Skinner, C. E.

ON October 24th, by far the longest suspension bridge in the world was opened to traffic with much ceremony—the George Washington bridge across the Hudson river between Fort Washington Park, New York City, and the New Jersey Palisades. The river span of this bridge is 3500 feet. Its floor, 120 feet wide, is suspended 250 feet above the river by four cables which pass over towers 635 feet high; the floor being hung from the cables by sixteen twisted steel ropes every 60 feet, each rope with a breaking strength of nearly 800,000 pounds.

The roadway is proportioned for eight traffic lanes for automobiles and 25-ton trucks, giving an estimated capacity for more than thirty million vehicles annually. The structure is strong enough for the future addition of a lower roadway of equal capacity. At the New Jersey end the roadway is continued through a rock cut 150 feet wide and 50 feet maximum depth, which is more than 700 feet long. On the New York end, the roadway passes over an approach supported on a concrete arch spanning Riverside Drive.

The total cost of the bridge will be about \$75,000,000; which sum will, it is expected, be amortized in 22 years by moderate tolls. The bridge was financed by the Port of New York Authority.

The west tower is supported on two concrete piers nearly 100 feet square and resting on rock 80 feet below the river surface, built by Silas B. Mason in the deepest large open cofferdams ever constructed. Each of the twin cofferdams was made of two parallel sides of heavy steel sheet piles, the spaces between which were filled with concrete and sand, with six tiers of horizontal timbers more than 100 feet long for braces. The steel towers, each weighing more than forty million pounds, were fabricated in the shops of the American Bridge Co., the Bethlehem Steel Co., and the McClintic-Marshall Co. and erected by the last.

The most remarkable feature of the construction was the spinning of the four cables, which contained about 107,000 miles of 0.196-inch galvanized wire with an ultimate strength exceeding 220,000 pounds per square inch. Each cable contains 13,237 wires and has a diameter of 36 inches, and can sustain a maximum pull of 65,000,000 pounds (equivalent to a mass of concrete 100 feet square and 45 feet high). The construction plant and equipment for erecting these cables cost nearly two million dollars, and the labor involved a force of 300 to 400 men employed for 209 working days in spinning the cables.

The cables were constructed by the John A. Roebling's Sons Co., the organization founded by John



Above—View of the George Washington Bridge, and below eight of the sixty-one $4\frac{1}{2}$ -inch strands completed for each of two of the great cables.

A. Roebling, builder of the Brooklyn bridge in which cold-drawn carbon steel wire was first used. Although this firm has produced the wire and spun the cables for many suspension bridges since then, the construction of this unapproached span required the devising of new methods and development of special equipment.

In building spans scarcely more than half the length of this one great difficulties had been encountered in providing temporary working platforms for cable spinning, and the work was delayed or endangered by even moderate winds. For this bridge, there was developed a 3500-foot span suspension foot bridge of entirely new design, with storm bracing that held it rigid, practically eliminated vibration, and enabled the cable spinning to be carried on safely and uninterruptedly throughout the winter storms. Two of these temporary bridges were used costing \$600,000, and equipped with more than \$100,000 worth of electric light, power, and signal apparatus designed especially for this work and which were necessary for its execution.

In placing the wires for the cables, loops of wire were hauled across the river to the opposite anchorages by eight spinning wheels attached to four aerial tramways, and attached to the anchorages. When 217 had been spun they formed an endless skein that was seized to make a $4\frac{1}{2}$ -inch strand, which was adjusted, before sunrise or on a cloudy day, to exact required curve and tension. Each cable contains 61 such strands.

Although this bridge has double the span of any predecessor, it will soon be surpassed, as construction will soon be begun on the 4200-foot span of the Golden Gate highway bridge at San Francisco, made possible by the methods devised for this bridge.

Canton, Ohio, Uses Liquid Sludge on City Farm

By Chas. C. Hommon

Sanitary Engineer in Charge of Sewage Treatment, Canton

THE Canton, Ohio, sewage works is of the Imhoff tank trickling filter type. It was designed for a population of 135,000 persons, and it is estimated that approximately 100,000 persons are now contributory to the plant. It is located about eight miles south of the city on what is locally known as the municipal farm, which is operated as a part of the sewage works and under the management of the plant superintendent. The farm is comprised of nearly 600 acres of quite rolling land, 200 acres of which are either wooded or too rough to permit of economical cultivation. Located on the above acreage at advantageous points are three residences and barns, around which all agricultural activities of the enterprise are centered. Three city employees live in the three residences and work mainly on the farm and care for the city-owned live stock and farming implements. All farm products are sold at the best market price by the superintendent of the sewage works, the money being turned into the general fund of the City of Canton. The common crops raised are wheat, corn, oats, hay and potatoes. The farm is operated as a part of the sewage treatment program for the express purpose of providing a means of disposing of the sewage sludge.

The sewage plant is located near the middle and at the extreme western side of the farm, along the bank of Nimishillen creek, a small stream into which the plant effluent is discharged. The sludge pumping equipment for transferring the wet sludge as drawn from the sludge wells of the Imhoff settling tanks to the farm land consists of two triplex 10"x10" plunger pumps, powered by 40 H. P. 220 volt motors, and approximately 5,500 feet of 6-inch force line. Each pump has a capacity of 300 g.p.m. operating at 30 r.p.m. The force line lies about midway between the north and south boundary line of the city's property and terminates on the top of a knoll which is approximately 300 feet above the surrounding territory. From this high point the sludge is flowed in open ditches following the contours, to acreage as far as two miles. The ditches are formed usually by means of an ordinary farm breaking plow. The force line is also provided with suitable connections, 6-inch by 6-inch by 3-inch tees, at points where it is desired to distribute sludge from time to time.

At the time of pumping sludge on to the ground, three men are required for proper distribution. The spreading of the sludge is accomplished in the simplest manner, by keeping the open ditches at the highest elevations possible and allowing the ditch to overflow at proper intervals to cover the desired area. If all of the sludge is flowing into one ditch, there are usually three points of overflow, each man caring for approximately one-third. Due to the sloping topography of most of the area, it is possible for the

laborers to follow down the slopes in front of the sludge and, so to speak, fan it out by miniature ditches and dikes, and in this way cover relatively large areas from one point of discharge.

Many observations have been made to determine the best condition of spreading the wet sludge, and it appears that there are but few choices, the most difficult condition being excessive slopes on hard, dry ground, devoid of any vegetation. Under these conditions it is difficult to retain the sludge in limited areas. Any appreciable amount of vegetation, however, retards the flowing sludge to a remarkable degree and renders it possible to cover satisfactorily relatively steep slopes. Likewise, snow during the winter months assists materially in spreading the sludge by retarding the flow. On ground that is relatively poor, on areas which it is desired to sludge heavily, it is best to first plow. The plowing not only loosens the ground, which permits of ready absorption of the contained water, but the small pockets formed on the surface by the plowing affords ideal catchment areas for the sludge.

In the way of an experiment, a part of this year's fall wheat crop was planted and then covered with sludge, and the results appear to be very satisfactory. The wheat in the sludged areas is much in advance of that in the unsludged areas. The same general scheme was tried with this season's corn crop. The dry weather was seriously interfering with the growth of corn, and wet sludge was applied to the ground about the time when the ears were being formed. On the ground where sludge was applied the corn was much superior, not only in quantity, but quality. On numerous occasions the value of the sludge as a fertilizer for grass has been well demonstrated, not only in a small way on lawns, but also on meadows, the hay from which was used as stock feed.

To be used intelligently, one should know something about the food requirements of the respective crops, the character of the soil, and also something of the character of the sludge. For instance, it is well recognized that clover requires an alkaline soil, whereas most sewage sludges are inclined to be slightly acid. It therefore follows that sludge is not a complete fertilizer for such a crop and requires the addition of sufficient lime to develop the proper reaction. Likewise, in the fertilization of oats, grown on ground fertilized with sewage sludge, one must apply the sludge sparingly, otherwise the growth becomes excessive and the crop is most likely to fall down before or soon after heading, and thus complicate harvesting of the grain.

The length of time such a scheme, as above described, could be employed for disposing of sewage sludge from approximately 100,000 persons on the

(Continued on page 69)

Traffic Line Marking—Some Observations and Suggestions

IN AN article which will appear in an early issue of PUBLIC WORKS, the relation between automobile accidents and proper traffic control as it relates to the use of traffic stripes is discussed. Without in any way trespassing on the subject covered by the author of that article, it is the intention to present here, for discussion and criticism by anyone interested, a few observations and suggestions on the same subject.

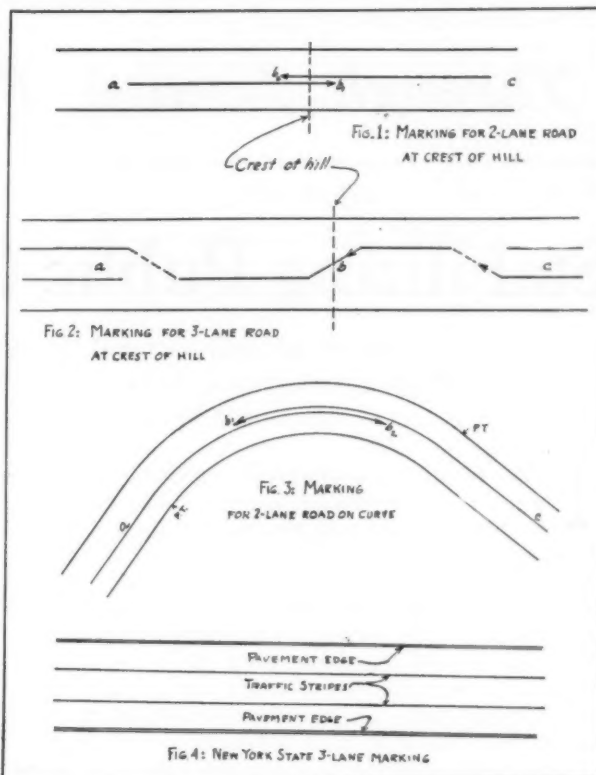
At the present time in the east, at least, all principal roads have a center stripe for a distance on both sides of the crest of a hill, this distance depending upon various factors of grade and sight distance. The Pennsylvania method is illustrated on page 30 of the August issue. The motorist is not allowed to cross this line at any point.

Obviously, however, a motorist who has reached or passed the crest of the hill can see the road for a considerable distance ahead, and if this is clear, there is no danger in passing a vehicle ahead. In fact, where trucks or the slower buses are to be passed, this is the best place, because even a large and heavily loaded truck will rapidly pick up speed while going down the incline, and so can keep ahead for a time—possibly long enough to hold all traffic to a 4-mile gait on the next hill.

As the motorist can not be trusted to use his own judgment in regard to a safe passing point, a marking such as is shown in Fig. 1 is suggested for a 2-lane road, and the one shown in Fig. 2 for a 3-lane road. The stripes in Fig. 1 might be placed 6 inches apart. They should extend slightly past the crest of the hill, probably, before ending at the arrow shown. A motorist going from *a* toward *c* would be allowed to cross the line *b₂c* any time after passing the *b¹*. In Fig. 2, assuming the 3-lane road to be marked into individual lanes as is the custom in a number of states in the east, the crossover shown at *b* might be used, but undoubtedly a better one could be devised, possibly making an enclosed "dead" area not to be crossed, at the crest, or extending beyond it slightly both ways.

In general, the same condition exists in the case of most curves, it being safe to pass, when coming out of the curve into the tangent, as soon as view can be had along the tangent, but dangerous to pass, when approaching the curve, for some distance back from the beginning of the curve; the exact distance will depend, of course, upon the sight distance at that curve. A suggested striping for curves is shown in Fig. 3. Under this system, a motorist traveling from *a* toward *c* could pass another car if the road were clear, any time after reaching *b²*. In the case of a 3-lane pavement, the same general marking method could be employed.

The marking of 3-lane roads, into 3 lanes, as shown in Fig. 4, is a decided improvement in a number of ways. General observation while doing a good deal of driving is that it is popular and fairly successful in holding drivers into their own lane and reducing the custom, dating back to lumberwagon days, of



Suggested methods of highway striping for Better Traffic Control.

holding the center of the road just as long as possible. That was all right and quite safe when vehicles attained the high speed of 2 miles an hour, but it is not safe when usual driving speeds run twenty times as much.

In one or two places in the east, the inside and outside edges of curves have been striped also. This is another decided improvement, but it is not employed generally enough. In daytime driving, it is much easier to see the white stripe marking the edge of the road, using one corner of the eye, while watching oncoming cars with all remaining optical equipment (which is usually necessary). At night, the outside marking is even more of an aid; in fact, it is a distinct contribution to safe driving. Curves certainly should be striped on both inside and outside edges. And it is our own belief that all roads should be striped on both edges so as to show plainly where the pavement edge is located.

Striping costs money, of course. But it is much cheaper to do it than it is to pay the cost of accidents. Accidents, of course, are usually paid for directly by the persons involved, or by the insurance companies; but indirectly they are paid for by the entire community, and are a burden on it.

A further discussion of this factor of costs of striping vs. accidents will be presented in the forthcoming article already mentioned.

PUBLIC WORKS Urges

UNEMPLOYMENT RELIEF

Through Needed Public Improvements

Stabilizing Public Construction Work

Abstract of an address by D. H. Sawyer, director, Federal Employment Stabilization Board, before representatives of the Institute of Builders of Great Britain, Washington, D. C., Oct. 1, 1931

THE Federal Employment Stabilization Board was created by the last Congress as a medium to gather complete and trustworthy figures of construction, coincident with existing figures of business conditions, so as to anticipate matters which might affect employment. The Board is also charged with bringing about the advance planning of Federal public works, as well as encouraging states, counties and cities to do the same, in order that projects anticipated years ahead may quickly be released in times of stress, thus relieving unemployment.

The present depression has proved that the private dollar is usually frozen and unavailable for circulation, or seeks a retreat from which it is difficult to be extricated. The public dollar is in the custody of selected officials, and if advance plans have been devised for its utilization, it is entirely feasible to release this money for useful public works, and thus play an important part in assuaging unemployment.

The Stabilization act provides that "Each head of a department or independent establishment having jurisdiction over one or more construction agencies shall direct each such construction agency to prepare a six-year advance plan, with estimates showing projects allotted to each year." The customary procedure of the construction agencies of the government has not been to design or plan construction projects, except as these were contemplated a year or so ahead. The exigencies of the moment were in most cases the absorbing thought. Under these circumstances, it was difficult to put on the market useful projects on short notice.

The bill contemplates that the Board shall "advise the President from time to time of the trend of employment and business depression and unemployment in the United States or in any substantial portion thereof." It further stipulates that "Whenever, upon recommendation of the Board, the President finds that there exists, or that within the six months next following there is likely to exist, in the United States or any substantial portion thereof, a period of business depression and unemployment, he is requested to transmit to the Congress by special message, at

such time and from time to time thereafter, such supplemental estimates as he deems advisable for emergency appropriations, to be expended during such period upon authorized construction in order to aid in preventing unemployment and permit the government to avail itself of the opportunity for speedy, efficient, and economical construction during any such period.

Under this mandate the Board cannot do otherwise than delve deeply into the realm of statistics in order that its conclusions may be trustworthy.

For years past various branches of industry have developed tables and charts which readily lend themselves as reliable barometers to business conditions, and the Board will not duplicate this effort, but rather devote itself to interpreting this information. The data which it is desired to uncover may roughly be grouped into "employment in construction," "production or shipment of basic materials and equipment of construction," "contracts awarded," "building permits," and the "financing of construction." Each of these follows the other in forecasting men at work, and taking into account the completeness and accuracy of the items which make up these groups, the curves should run parallel and serve as a check one against the other, depending upon the characteristics of the sequential lag.

Employment in the construction industry has not been closely studied, and authentic and complete figures are not as yet available. The Department of Labor has undertaken this and will probably have currently available data which will indicate the ups and downs of men at work. In certain divisions of the construction field responsible data on employment may be gathered, such as the number of men employed on various construction projects of the government. This work is of such a diverse character and of sufficient magnitude to produce a reliable trend as far as Federal construction is concerned. States, counties, and cities may do likewise. While these categories relate largely to public work, the architectural type of private construction can be analyzed for employment through co-operative agencies in the cities. Thus,

though it may not be possible to establish mathematically the men at work in particular types of construction, certain reliable methods of sampling can be employed which will give a trend just as faithful in its results as if numerical completeness was attainable. Again, it is readily possible to ascertain the employment of men in certain specialized lines of construction in relation to the cost of the work and thus establish a ratio which will be fairly accurate.

In the field of *production or shipment* of materials and equipment of construction it should be possible to chart more correctly than heretofore the cost of construction based on the weighted value of materials and equipment, together with wages paid to labor and other relevant factors.

Contracts awarded is a statistical group which has been studied for years past by trustworthy agencies.

Building permits apply almost entirely to the architectural type of building operations and statistics which are readily obtainable in most of the cities of the country can be employed in forecasting men at work. It has been discovered that there is no standardized method of recording this type of information and its importance warrants exhaustive study to insure proper interpretation being placed on this class of data.

Financing of construction can be broken down into three general groups: Financing of private enterprises; budgeting of the utilities, funds for public work flowing from bond issues, assessment proceeds; and appropriations by public bodies such as the government, states, counties, and cities. Depending upon the reliability of the information, it should be possible to develop charts in these three categories so as to forecast the probable trend of employment further in the future than any other information will permit.

In this explanation of planning and statistics a realization of the functions and the opportunities of the Stabilization Board is readily apparent and through the co-operation of those who are in a position to supply information and express judgment it will become an indispensable instrument of public service.

What the government can accomplish can be multiplied if states, counties, and cities will fall in line in the planning of their improvements and in the analysis of the factors which control their progress. The National government has and probably always will execute a very substantial volume of construction work, but these other public bodies execute a vastly larger amount.

Stabilization has a very definite place in the business fabric of the country. Its greatest gain will probably flow from the self-analysis of groups of like businesses. If this is well thought out, the results will be a measurable contribution in the elevation of industry to a point where peaks and valleys are less pronounced. And while they cannot be expected to disappear, their effects will be less significant.

Highway Bridges for Unemployment Relief

"Bridge construction is particularly suitable during a period of unemployment because labor receives a greater share of the bridge-building dollar than for other highway activities in which machinery performs much of the work," says O. W. Merrell, director of highways of Ohio, and he expects to construct 350 masonry bridges this winter, providing work for thou-

sands of residents and putting \$3,500,000 into circulation.

These bridges are all needed; in fact, a survey showed that 1600 bridges were too light to carry safely the legal traffic load. Most of them will be of concrete, and heating of the materials will be necessary for winter construction and a plant set-up that will protect both the structure and the workmen.

It is planned to let contracts for these bridges in November and December. Each contractor will be given a list of the unemployed in the community where he is to build a bridge by a committee of that community.

How One Community Plans for Unemployment Relief

A VILLAGE in New York State of about 4,000 population has made up the following outline of work for unemployment relief. In planning this work, it was estimated that the employment of 1% of the population for a period of four to six months would afford the necessary relief. (A discussion of this will be found on the editorial page.) Most of the work is that which ordinarily would be done in the near future, or is now needed.

Water Works Improvements

- Extending 12-inch pipe line about 1500 feet.
- Planting trees on the watershed.
- Replacing a 4-inch line with 6-inch.
- Repairs on present 8-inch line.

Street Improvement

- Repairing curbs.
- Rounding off curb corners.
- Resurfacing streets in outlying districts.

Sewage Treatment Plant and Sewers

- Extend sewers to resort hotels near village limits.
- Remove and wash contact bed stone from abandoned treatment plant.
- Wreck old plant.
- Landscape new plant.

General Improvements

- Paint city hall.
- Paint fire stations.
- Plant trees along residence streets.

The water improvements are urgently needed, except for the tree-planting, which costs about \$8 an acre, practically all for labor. The street improvement work, while not urgent, can be done now at a reasonable cost, and is desirable. The extension of sewers to resort hotels near or outside the village limits will improve health conditions, and through increased sewer rentals will pay for themselves within a year or two. The old plant should be demolished and the new plant should be dressed up. Both will be done eventually—why not now? The stone in the contact beds can be washed for \$1.25 per yard labor cost, and used on the streets. New stone costs \$4 per yard. Needless to say, painting and refurbishing of the municipal buildings seem necessary always.

Whether or not this plan will be carried through in its entirety is as yet undecided. The problem of financing this work is, as in the case of most communities, a serious one, but every effort is being made to meet this situation constructively and sensibly.

Note: Additional discussion of unemployment relief will be found on page 34.

THE READERS PAGE

Sanitation in a National Guard Camp

The "Cattle War" in Iowa may interfere with the "Water Wheel" grinding out as much flour this month as usual. Jack J. Hinman, who puts an almost unbelievable amount of work on the "Wheel" each month, wrote us on September 29:

I have been away from home most of the time for the last week, having been called to duty with the Iowa National Guard in connection with the "Cattle War." This is an affair which has grown out of the opposition to the anti-tuberculosis testing of cattle. The farmers of Cedar County have defied the veterinary officers and the deputy sheriffs and have attacked them. Consequently after a mob of about 300 stood off some 65 officers, the governor called out most of the units in the 133rd and 168th Infantries and the 113th Cavalry. I went along as gas officer and am now camp sanitary officer. The water supply of the county fairground, where we are encamped, is bad. The difficulty is the usual one of failing to protect the top of the casing of a deep well against surface drainage. We have laid about 3,000 feet of temporary 2½ inch pipe to the nearest city hydrant in the county seat town of Tipton and are using that water. The analysis of the city water in July was good. We put chloride of lime in each joint, then flushed the pipe line, but the first test was not entirely satisfactory. Other tests are now going through the laboratory.

Our participation in the affair has so far been without active opposition or bloodshed, though we have taken a few prisoners. I spend most of my time with a can of chloride of lime in my hand. If it is not that, it is "Flit." We expect to go home about Friday of this week. Part of the 133rd has already been released. I will just about get back in time to start on the next manuscript of the Water Wheel.

Newspaper reports show that trouble broke out again the following week, and part of the National Guard was still in active service on October 15.

Curve Superelevation and Widening

In a letter to PUBLIC WORKS, Boyd C. Affleck, city engineer of Nelson, British Columbia, says:

I have been particularly interested in your articles on Curve Superelevation and Widening, but it is only in Mr. Bate's article that I have seen any recognition of the short radius curve in these discussions. I have just constructed a 20-foot pavement on a 90-foot radius curve, with 1½ inches per foot superelevation, but had no authorities to guide me.

The Brownsville Water Purification Plant

An article with this title, written by Henry E. Elrod, appeared in our August issue. We have received a letter from Mr. Elrod in which he says:

I wish to call attention to the fact that there was a misstatement in the article, to wit: "Aerator Mixer—This is of the Link Belt 'Elevated Diffusor' type (patent pending), and is designed to aerate and mix 4.0 m.g.d. At this rate of operation, each gallon of water is aerated for one minute with one cubic foot of air," etc. I don't know how I made such an error, but I did, and I would be pleased to have you mention the fact. It is apparent, of course, that each gallon of water is aerated with only 0.07 cu. ft. of air.

Los Angeles County Sewerage

Dear Sir:

The writer has noted in your August, 1931, issue that on page 51 you have quoted him as stating as follows:

"About 110 m.g.d. of sewage is collected from the City (Los Angeles), north of 120th Street and adjoining cities, and discharged into the Pacific Ocean at Hyperion, while in the Harbor District the flow is 6 m.g.d., and will probably be 30 m.g.d. within the next five years."

In the chapter which the writer prepared for the State Department of Public Works, he made the following statement with reference to the work in the Harbor District:

"Following the plan, which has been proposed, that the sewage in the Harbor District be combined with the sewage from the Los Angeles County Sanitation District at the treatment plant now in use by the County, there would be at least sixteen million gallons per day of sewage flow, which would probably increase to thirty million gallons per day within the next five years."

According to the way in which this matter is brought out in the August issue, it would appear that this rapidly growing city has a Harbor District where the flow would increase five-fold in five years, which, of course, is erroneous.

Los Angeles is growing, but does not expect to have any such great increase as indicated on page 51 of said issue.

Yours truly,

J. J. JESSUP, City Engineer.

By W. T. KNOWLTON, Sanitary Engineer.

Water Services and Location of Mains

Public Works:—

In a recent item on your Readers Page you asked for the opinions of water works operators and engineers as to the practice in many cities of requiring the water department or company to place water service connections extending to the curb line for each vacant lot before the street is paved. The case of Columbus, Ohio, was given as an illustration of the resulting condition of this practice where there was reported to be nearly 20 per cent of the total water services inactive with a probable investment of about \$142,000 in these non-productive service installations.

This question has been debated and discussed very frequently in the water works journals and at the conventions. It has seemed to be a choice between two very objectionable evils, that is, to place services in advance of paving or to cut the pavement when new service connections are required.

During recent years the two-main system has often been proposed and in some places it has been adopted to a limited extent. It is seriously doubted that those who have used the two-main system have really carefully considered the financial and hydraulic economics of this arrangement for it is certainly most uneconomical and poor design. Every distribution system should be designed for the maximum flow capacity that can be obtained at a reasonable cost to meet fire flow and peak consumption demands. When the extra costs of the double main system are weighed against the slightly added cost of longer services for the single main, it will be found that a single main of adequate size for all future needs can be had and in most cases save money. It seems that all the arguments for the two main system revolve about the advantages of not having to cut the paving and forget the prime necessity of obtaining the greatest hydraulic capacity possible for the funds expended.

It seems to the writer that there is a rather obvious solution. What good reason is there why a single water main cannot be placed in the parking strip in all residence sections? The advocates of the two main system usually lay both mains in the parking. It is certainly the place for water mains whenever possible, for not only can new services be connected but all repairs to the main or services can be made without disturbing the pavement. Certainly co-operation between the city engineer and the water department will enable them to fix a location in the parking that will not be objectionable to either the city, the property owner or the electric and telephone utilities. Then the new services required after the street is paved can be placed with a pipe-pushing machine or a hole can be drilled under the paving in the places where it is found sometimes necessary. It will be found that the labor costs for new services will average less than where pavement cuts with tunnels between are made for placing services and in many cases no more than for work in totally unimproved streets. Besides the saving in large non-productive investment for

(Continued on page 72)

THE EDITOR'S PAGE

Gas Dangers in Sewage Treatment Plants

When an explosion occurs in a sewer and blows a few manholes—and sometimes passersby—into the air, it is usually stated that either illuminating gas from leaky mains or gasoline from garages was responsible, and this is probably correct, in most cases, at least.

But if "sewage gas" is not responsible for such explosions it is because (or when) no sewage, or too little, remains in the sewer long enough to develop it in sufficient quantities. But such is by no means the case in septic or sludge digestion tanks. In these the sewage may evolve as much as one-third cubic foot of gas per capita per day, all of which is inflammable, and it follows that great care should be taken that the gas is ignited only where and when no damage will result.

Elsewhere in this issue we tell of an explosion in a sludge digestion tank by which two men were killed.

A number of similar explosions have occurred in septic tanks during the past twenty-five years, but the modern covered digestion tank wherein the production of gas is stimulated by provision of favorable conditions, and escape of the gas except through the pipes provided is prevented, would seem to be the most dangerous of all sewage treatment appliances so far as gas is concerned.

The danger exists in the possibility not only of explosions, but also of suffocation or poisoning. In September of last year four men lost their lives while cleaning out a covered septic tank at Kitchener, Ontario, presumably through poisoning by hydrogen sulfide generated by the sludge in the tank.

This is no argument against the use of sludge-retaining tanks, but a warning that danger exists which should be recognized and kept in mind. As provision against it, gas masks may be used, but it would be much preferable to require a test for gas to be made at all times before allowing men to enter such a tank, forbid carrying a light on striking a match in it (since stirring up the sludge may release gas accumulated therein), and to minimize the necessity of sending men into the tank by providing mechanical means of removing sludge and of performing as many more of the necessary operations as possible.

How Much Unemployment Relief Work Is Necessary?

With unemployment estimates running all the way from 4 or 5 up to 6 or 7 per cent of the population for the United States as a whole, what per cent of the population must a community plan to employ in order to afford relief?

It has been the experience of a number of municipalities that if unemployment relief work is made available on the basis of 1% of the population for a period of four or five months, the major emergency will have been met. Thus, in a city of 10,000 population, plans should be made to employ 100 men over the above period. Whether these are to be put on

a part-time or a full-time basis, will depend largely upon local conditions and the money available. Wage scales may be lower than average labor rates to encourage men to look for other jobs, and if the men are worked only 4 days a week they will have time to seek such other jobs; although some cities report that local employers have used such low wages as an argument for reducing regular wages, and therefore favor paying the standard scale.

This estimate of 1% may not hold good in every community, for much depends upon local conditions; but, from experiences in such work last winter and from studies for the coming winter, it appears to be a reasonable basis of estimation for average conditions.

Industrial Wastes in Streams

Twenty-five years ago stream pollution was considered to be confined almost entirely to domestic sewage. But during recent years the pollution caused by industrial wastes has been increasing in volume and intensity until it has become the chief offender in many streams.

Nor are the offending wastes confined to manufacturing cities. Creameries, canning factories, laundries, dry-cleaning establishments and other industries are found in small villages and in purely residential communities, and discharge into sewers and streams wastes that may create more of a nuisance than the domestic sewage from the same communities.

It is common practice to estimate the strength of these wastes in terms of the number of individuals who would contribute to the sewers an equivalent amount of putrescible organic matter; but there are other contents to be considered. Some wastes carry acids in such quantities as to kill fish in the stream and eat out boiler tubes. The Illinois State Sanitary Water Board, created in 1930, found that waste oil from 15,000 wells made the water of the Wabash "unfit for domestic stock or aquatic life and caused periodic damage to crops when the river overflowed."

Practically all classes of wastes discharged into sewers have a greater or less effect—generally detrimental—upon the operation of sewage treatment plants, even of those features, like screening or sedimentation, whose functions are entirely physical.

The practical application of the above considerations which we would make is this—that, should an engineer engaged upon designing a sewage treatment plant or otherwise remedying stream pollution base his plans upon the assumption that the pollution is a product of the population times a certain per capita amount of domestic sewage, such plans may result disastrously if any waste other than domestic sewage is produced by the community; and that means more cases than is generally realized. It is unsafe, and becoming increasingly so, to base any such plans upon anything less than a thorough investigation to learn what kinds and quantities of wastes are to be provided for, and what the effects of each will be—physical, chemical and biological.

Cities Giving Unemployment Relief Through Public Works

AT THE conclusion of the convention of the American Society of Municipal Engineers in Pittsburgh, on October 23rd, that society held a meeting of those both inside and outside of its membership to discuss the unemployment problem and compare notes on the operation of methods already used by different cities for ameliorating conditions which many fear will develop more serious proportions during the coming months. About sixty were present.

The principal features of this meeting were descriptions of experiences in unemployment relief of Pittsburgh, by Charles M. Reppert, chief engineer of the Department of Public Work; of Grand Rapids, by George Welch, city manager; of Rochester, N. Y., by C. Arthur Poole; and a general discussion of the problem by Miss Colcord, of the Russell Sage Foundation, with special emphasis on the value of using social workers in determining what individuals most need assistance and the form that assistance should take. Representatives of other cities took part in the discussion.

There seemed to be general agreement that, wherever possible, work should be provided rather than a dole; also that the work should produce something of value to the community.

It was realized that in few if any cases could as much value be obtained for the dollar spent in this way as for that spent in ordinary procedure. Rochester calculated that last year it obtained an average efficiency of 50 percent and Bridgeport 40 percent, of that obtainable by regularly employed labor.

Moreover, the percentage varied with the class of work. For example, in Rochester some heavy grading was done with pick, shovel and wheelbarrow instead of by power shovel and trucks, which the latter could have done for 15% of the cost; however, work performed by mechanics cost only about 25% more. But at least the city obtained 50% value for the money paid for labor, while if it had paid this out as a dole it would have spent nearly if not quite as much with no return, and would have undermined the morale of the recipients.

Some considered this last point of great importance. They found a growing spirit of bitterness in the unemployed, and believed that food without employment would do little to reduce this feeling in many of them. Several advised segregating the employed according to the class of work they had done, as clerks, professional men, mechanics and day laborers, even though all should be doing day labor. Also, avoidance of making a display of the men, especially those of the "white collar" class. Effort should be made to find for the latter some more intellectual job than cleaning up streets and parks. In Philadelphia such men are used for making traffic counts, various thoroughfares and preparing maps and charts of the results; and in designing and preparing traffic signs. Other possible employment of these is as additional clerks in libraries, museums, etc.

For day labor there appears to be abundance of work everywhere; but it needs some thought and intelligence to select that which will require the least expenditure for material and expert oversight and

will give fairly efficient results with a minimum of equipment. If possible, none of the money available should be used for equipment, but works selected that can be carried out with equipment already on hand. Pittsburgh plans to use 1100 men this fall and winter on grading and surfacing 50 to 60 miles of dirt streets in the city—it has already graded and guttered 26 miles. Street paving can be done only under assessment proceedings upon request of a majority of the property, and this it is impracticable to obtain; but this restriction does not apply to sewers, parks and other public works.

In Grand Rapids, one of the first problems was money, and they selected work to be done under those departments which had unappropriated budget allotments. The water department was one of these, and its funds were used for laying mains with picks and shovels.

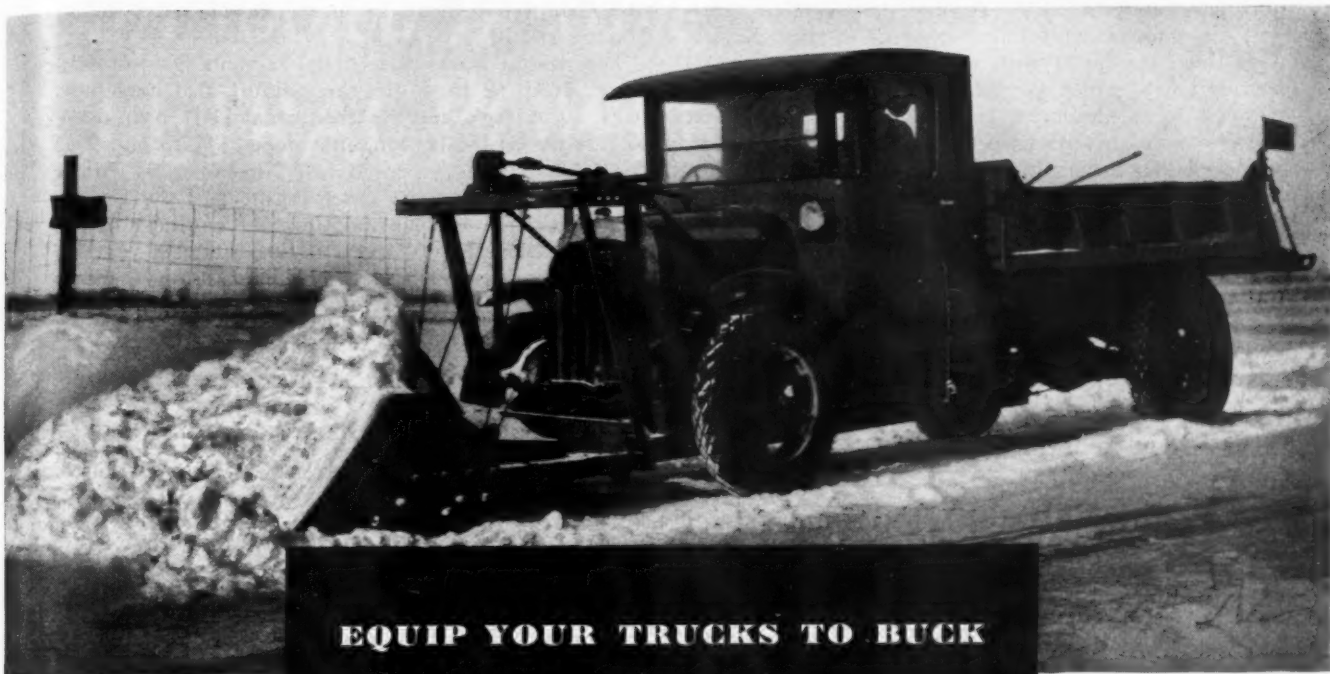
Rochester did considerable work in cleaning up the interiors and exteriors of public buildings and painting them, as well as clearing the grounds, pruning trees, cleaning monuments, etc. A number of buildings were erected on public land, utilizing skilled labor, among them a building for the boy scouts, rest rooms for skaters at the parks and others.

In the apportionment of work and amounts of wages paid there was considerable difference of practice. In several cities the aim is to furnish aid in proportion to necessity. A man with a family of six children is given more days of work than one with only one or two. If it is discovered that he has other means of support (such as a house which is rented) he is refused work. Determination of the individual needs is best performed by social workers, in the opinion of the Sage Foundation, and several cities reported using them; while others, like Grand Rapids, have a welfare department which performs this service. In at least one city all of this was nullified because a letter from a councilman took precedence over the recommendation of the social agent in securing work for the bearer.

In several cities applicants for work are given a physical examination to determine whether they are capable of performing heavy work, or light work, or no physical work. (One city was sued in a large sum for a case of hernia contracted by one of its emergency employees who had been put at work for which he was physically unequal.) It seems desirable, also, to break into physical work gradually those who are not accustomed to it, by giving frequent rest days at first. Several advised taking out workmen's compensation for the protection of the city.

In the matter of wages there is a difference of opinion. The Sage Foundation recommends paying union wages and prevailing rates for common labor, but so regulating the number of days labor per month that each receives only the total amount required by his necessities as determined by the social worker. Others believe in giving less than regular wages so as to encourage the men to look for regular jobs. The argument for payment of the regular scale is that, in some cities where the lower wages are paid, this has resulted in a lowering of wages all around.

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In Pittsburgh the foremen can lay off men who are incompetent or loaf, and this was recommended generally. It was suggested that men who refused to work and those who, receiving money from the unemployment fund, failed to use it to support their families, be punished by imprisonment. Grand Rapids pays those employed with scrip (\$1 and 20-cent denominations), which is receivable only for food distributed by a municipal commissary. It found that money was not always used for the support of families, and even that orders for food would be sold or otherwise squandered. On the other hand, the Sage Foundation believes that paying cash is necessary to preserving the self-respect of those who have never before been in such a position, which class is that for which this work is chiefly necessary.

The Sage Foundation, in its study of the subject, has obtained answers to questionnaires from 576 cities; and will issue, about November 20th, a report based upon an investigation of the experiences of about twenty-five cities.

To Build \$220,000,000 Aqueduct

THE voters of Southern California, by a vote of about 5 to 1, have authorized the Southern California Metropolitan Water Board to carry out the most ambitious water program ever put through—the building of an aqueduct 265 miles long to carry an average of 1500 second-feet of water from Parker canyon of the Colorado river to the vicinity of Los Angeles, at an estimated cost of \$220,000,000.

The intake at Parker canyon is about 150 mi. below Hoover dam, almost due east of Los Angeles. A dam may be built at this point which will serve to divert water into the intake, to furnish power for pumping and to catch the silt carried by the river below Hoover dam until it clears up. The power obtained from the dam would pay for its construction. The construction of this dam, however, is contingent upon California and Arizona coming to an agreement. If the dam is not built, power can be obtained from the Hoover dam.

From the intake the water will be lifted 539 feet, then pass through the Whipple mountains in a 12.3-mile tunnel. After this it will flow through 51 miles of gravity aqueduct of either lined canal or cut and cover conduits, followed by a tunnel through Granite mountains, then alternating open cut and tunnels, with three pumping lifts of 214 ft., 283 ft. and 487 ft. respectively. At the foot of the third lift will be a reservoir of large capacity which can be provided at nominal cost and will serve as an equalizing reservoir. From the top of the third lift, at elevation 1817, the flow will be entirely by gravity to the end at Puddingstone reservoir, elevation 1000, there being one steep drop of 406 feet. More than half of this section will be in tunnel as the aqueduct follows for more than 100 miles along the southern face of the San Bernardino mountains, then through the San Jacinto mountains.

In all there will be 74.12 mi. of open canal, 80.26 mi. of closed surface conduit, 2.20 mi. of pressure tunnel, 22.65 mi. of grade tunnel with shafts, 67.75 mi. of grade tunnel without shafts, 0.51 mi. of steel siphons and 15.91 mi. of concrete siphons and pipe lines.

All of the tunnels will be in sound granite, but there are two faults known as San Andreas fault and the San Jacinto fault lying across the route, which will

be crossed at the surface, where precautions can be taken against destruction by movement of the fault (presumably by earthquake, although even engineers in California avoid the use of that word when possible) or repairs can be made most easily should damage result.

The design shows the tunnel sections horseshoe in shape, 16 ft. 2 in. high; the conduit also horseshoe, 16 ft. 10 in. high, and the lined canal 11 ft. 3 in. deep, 26 ft. wide on the bottom, side slopes $1\frac{1}{2}$ to 1.

This route was proposed last November by Frank E. Weymouth, formerly chief engineer of the Bureau of Reclamation and since 1928 chief engineer of the Southern California Water District, after six years of study of the project. The route was approved by an Engineering Board of Review in December, and finally adopted by the directors of the district on January 16.

Most of the Road Dollar Goes to Labor

In an address before the American Association of State Highway Officials, Thomas H. MacDonald, chief of the Bureau of Public Roads, said: "Direct labor costs on the simplest grading work may run to more than 80 per cent of the total expended, but for the types of road which are being built to meet the actual needs of traffic the average payment to labor directly on the work would be between 20 and 30 per cent. This does not, however, represent the value of the road dollar to labor.

"Although it is exceedingly difficult to analyze, because of the wide variations in types of work and all other conditions, there is a very general agreement among highway executives that upwards of 85 per cent of the road dollar goes eventually for labor and personnel employment. The road dollar spreads back through stone quarries, sand and gravel plants, cement factories, petroleum fields and refineries, mines, engages rail and water transport facilities, and keeps the wheels of equipment and accessory factories turning. Labor and personnel employment in all of these receive a part of the road dollar."

Employ Independent Engineers on Public Work for Unemployed

At a recent meeting of the Board of Direction of the Western Society of Engineers a resolution was adopted calling attention to the fact that the normal engineering staff of most public bodies is not large enough to prepare the surveys, plans and specifications for an enlarged construction program such as is desirable for relief of unemployment, without considerable delay, and that there are numerous engineering firms competent and willing to perform such work in preparation for anticipated public improvements; also that the Federal government has established a precedent by employing competent firms of architects to expedite its building program; and requesting "the County of Cook, the State of Illinois, and the United States of America to employ immediately competent engineering firms to make said surveys, plans, etc., in order to expedite this work of relief, and to the end that the plans will be ready when the appropriations are made and no unnecessary delays will obtain in the actual construction of this vast amount of work."

A similar resolution was adopted last month by the American Society of Municipal Engineers.

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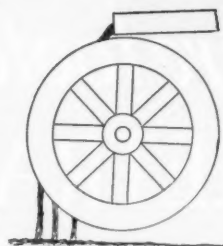


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THE WATER WHEEL

By
Jack J. Hinman, Jr.



DESIGN

LOOKING back over the last twenty-five years development in the design, operation and control of water plants, Hetherington¹⁰² finds that the outstanding feature has been the increasing demand for water and the consequent search for additional sources from which it may be obtained. The acceptance of mechanical or rather rapid sand filtration and of chlorination has been assured during this period. Much closer supervision of water supplies by central and local governments has been provided. Although Hetherington writes of British conditions, these points may equally well apply to American practice.

Miami, Florida, is using its reserve well field for an aviation port and plans to continue to do so when the development of the ground water is required¹¹⁶. Many of the drawings submitted during the recent competition of the Chicago Bridge and Iron Works³ for artistic elevated tank designs provided for aviation beacons or warning lights on the proposed structures. Newer water works plants show a strong tendency to better architectural treatment in the attempt to add dignity and beauty to the required structures instead of considering utility alone²².

In the search for water by geophysical methods an electrical procedure has been developed in Australia⁹⁴ which has been described at length. It is based on measurements of resistivity of the earth at different distances to discover uniformity or departure therefrom. It is expected that location of bed rock in dam sites, as well as water tables, salinity, and sudden changes in the character of underlying formations can be detected.

The location of the intake for the new Springwells station at Detroit, Michigan, has involved the construction of a great intake lagoon formed by dredging and the erection of dikes in the Detroit river for the purpose of regulating the approach velocity of the water. The water will have a velocity of about 3" per second for two hours before it is allowed to enter the intake and it is hoped that the installation will avoid troubles due to frazil or needle ice²⁴.

In connection with a discussion of the Chicago Avenue Tunnel now under construction, Verslus⁷⁰ has given much of the history of the other tunnels of the Chicago water works. There are now about 64 miles of water supply tunnels serving the city. O'Rourke³⁵ insists that the capacity of the Ford water tunnel at Detroit has been understated. The driving of the tunnels for the Cobble Mountain supply for Springfield, Massachusetts, had been described²⁹ as well as the power development associated with the project⁷⁶. The great bond issue of \$220,000,000 of the

The essential features of important articles of the month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted by a leader in the water works field. Published every month, to include articles appearing during the preceding month.

Metropolitan Water District of Southern California was approved by an overwhelming vote on September 29th and preliminary work on roads began the following day²⁶. Considerable tunnel work is involved in this project.

Pittsburgh is building a 170 Mgd electric pumping station which is to be completed by the end of 1931¹⁹. It is expected that by supplanting the existing steam plant greater economies as well as more satisfactory conditions in the vicinity of the station will be obtained. Economies with modern equipment are stressed by White²¹ and the arrangement of the modern pumping station is discussed by Burdick²⁰ who points out the need to consider the peculiarities of the local situation. With so many electrically operated plants installed in this country, it may seem surprising to learn that according to Immerschitt¹⁰⁰ more than 40% of the water supply of Germany is lifted by steam piston pumps.

Detroit has had to depend in part upon a temporary pumping plant of three 17 Mgd. centrifugal pumps during the past summer³⁰. Elevated steel tanks and booster pumping help to smooth out the pumping curve, but as Stephenson²⁵ indicates, the development of the distribution system presents an unending task in the effort to keep the supply up to the demand in all localities. Hebbbring⁷¹ has used elevated storage at Wauwatosa, Wisconsin, in the form of a 500,000 gallon and a 1,000,000 gallon elevated tank, supplemented by slightly greater storage at ground level.

Herman Schorer⁷⁸ describes the design of large pipe lines using full ring girders instead of the usual saddles for support. This design was of Swedish origin. At Bangkok, Siam¹⁵, carrying of a water main across a bascule bridge, involving electrical equipment to make and break the water connection when the bridge is closed or opened, required the use of complicated apparatus. Satisfactory operation is claimed. The 48-inch cast iron pipe of the Albany, New York, line leading from the Alcove reservoir, was made up with Leadite joints³³. Remarkably good results were obtained on leakage tests. Seth M. Van Loan discusses gate valves in water works systems most interestingly¹⁰. H. W. Griswold shows what development has taken place in the distribution system and its accessories within recent years. The improvement in valves, taps and other items is striking²⁸.

Another old cast iron pipe was dug up and inspected when the 30" line on Boston Common was exposed. This line laid with much ceremony in 1846 was of Scottish manufacture. Its condition was found to be excellent¹¹⁸. Two sections of bored wood pipe laid 47 and 58 years before were recently tested at Purdue

Look at This 85-Year-Old Pipe!



Mayor James M. Curley holding historic Ames spade used by Mayor Quincy and former President John Quincy Adams to start the excavation 85 years ago. George H. Finneran, Superintendent Boston Water Service at left.



(From Boston Globe
Sept. 30th, 1931)

"Mayor Curley at noon today threw a shovelful of earth over the first cast iron pipe used in Boston for water supply, uncovered in celebration of the 50th Annual Convention of the New England Water Works Association. The pipe is still serviceable and in perfect working condition."

LOOK at this *unretouched photograph* of an 85-year-old cast iron water main recently uncovered on historic Boston Common. Not only is it still serviceable and good for many years to come, but it looks like new. Yet it is Boston's first cast iron water main, laid in 1846 to replace pine logs. Former President John Quincy Adams dug a spadeful of earth for the excavation, and when the water was turned on, there was a holiday celebration on Boston Common and children sang an ode written for the occasion by James Russell Lowell.

Similar recent inspections of old cast iron mains in New York, Philadelphia, Chicago and Richmond have been made the occasions of notable ceremonies. In every instance, inspection has shown the pipe to be in excellent condition after 90 to over 100 years of continuous service and good for many more. In the majority

of large cities, the *original* cast iron water and gas mains are still in service, long after the bonds issued for their payment have been retired and forgotten. Cast iron pipe has saved and is saving many millions of dollars in taxes and rates. Shorter-lived substitutes inevitably cost the public more. For every citizen, directly or indirectly, shares the cost of underground mains, in the form of taxes, assessments or rates.

The reason for the long life of cast iron pipe is its effective resistance to rust. Cast iron is the one ferrous metal for water and gas mains, and for sewer construction that will not disintegrate from rust. This characteristic makes cast iron pipe the most practicable for underground mains since rust will not destroy it.

Every taxpayer should take an active interest in the kind of pipe being laid, or to be laid, in his community. For further in-

formation write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 122 So. Michigan Avenue, Chicago, Ill.

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Look for the "Q-check" symbol as shown above. It is the registered trademark of The Cast Iron Pipe Research Association.

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CAST IRON PIPE

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University¹². They were of white pine spirally wrapped with a steel band 1/16 inch thick. The wall was about 2 1/2 inches thick. The diameters were 10 and 12 inches. One had been in use at 60 pounds pressure and one at 90 pounds. The former was sound to within 1/4 inch of the inner surface but the latter showed wear. Tested in the laboratory, the first pipe withstood 150 pounds pressure per square inch, though some damp spots showed up. The other pipe cracked at 90 pounds. When the pressure was reduced to 50 pounds, the flow from the crack stopped.

Protection of an exposed 36-inch steel pipe line in New South Wales by the use of various covering materials and methods of their application has been carefully studied during the last 3 1/2 years during which time about thirty miles of the line have been covered. Preliminary tests on 160 combinations were reduced to 60 for actual trial on the pipe line. **Dark coatings** of tar and bituminous paints as originally placed were found to take up too much heat, the temperature at the outlet reaching 104°F. **White and aluminum coatings** were found to reflect the sun's rays. Aluminum paint was more opaque than the white paint. It could be laid over the tar coating if the latter was well dried before application of the aluminum paint. The required cleaning of the pipe was slow and difficult but each coating was put on a clean surface⁹⁹.

Papers of Special Interest:

Discussion of **run-off formulas**⁸².

Diagram for uniform flow in **open channels**—discussion⁸⁴.

Purification of **rivers** and streams, Henderson,⁹.

Sub-surface canals conserve water supplies in **Persia**, Eigenbrodt⁴¹.

Discussions of **dam designs**^{79, 81, 83}.

Plants involving **dams**: Madden Dam, Canal Zone³², Alameda Creek Dam, San Francisco³⁸, Scar House Dam, Bradford, England⁹⁵, Ware River project, Massachusetts¹⁰⁴, Hannacroix-Basic-Catskill Supply, Albany, N. Y.³¹.

Selecting **pumping equipment** for economical operation, Parrish⁷³.

Operating a **direct pumping plant** economically and efficiently, King¹⁰⁸.

Care of **pumps**, Nunn,¹¹⁰.

Pump, tank, or suction pipe usual sources of trouble in small **electric water systems**, Parrish⁷².

Painting of Standpipes, (Extract N.E.W.W.A. report)¹³.

Laying Mains in populous streets, Gidley¹⁰⁶.
51-inch line 20,575 feet long for **Little Falls, N. J.**³⁷.

Development of **aquaphones**, Stein⁴³.

Re-design of **condenser piping** of refrigerator plants to reduce friction reduces pumping cost, Vetter⁴⁶.

English-made **sand-spun pipes**^{16, 90}; automatically welded pipes⁹⁶.

Halifax Corporation Water Supply⁹⁷.

New 16 Mgd (Ultimate 32 Mgd) filter plant for **Erie, Pa.**¹²⁵.

Bow Island, Alberta, plant clarifies highly turbid water⁸.

Bolsover, UDC, (England) has new Kennicott Softening plant using "Kenzelite," a base-exchange compound⁹⁸.

Cooling water system for **Radio Station KDKA** is complicated⁴⁷.

The **Rand Water Board (South Africa)** reports¹⁴.

Sir Alexander C. Houston's 25th Report on the London water covers many subjects⁸⁷.

The **Memphis** artesian water supply and its development for 19 Mgd¹².

El Paso depends on 11 wells 500 to 860 feet deep for¹⁰ Mgd².

Concord, N. H., drove 150 wells 45 feet deep to avert water shortage²⁶.

The British Municipal Council of **Tientsin** uses deep well water¹⁰³.

Recovering lost drilling tools, Part III, Fiedler,⁵⁴.

Financial

Tacoma, Washington, has made very careful studies in the effort to pay upkeep and extensions out of water works income and yet keep the rates low enough to attract industries¹²³. Even in a small town, such as Johnstown, Colorado, effective low price purification equipment may be a factor in **retaining industry**²³. Small towns, such as Williamsport, Maryland⁸, that for years have existed without a public water supply have found that an adequate system reduces fire insurance rates and might actually yield revenue more than sufficient to retire the indebtedness rapidly. Once a water supply has been secured the citizens wonder how they got along without it. In a small town such as Williamsport, purchasing water in bulk from its neighbor, Hagerstown, the maintenance problem is at a minimum of complexity. In larger places, as Heffernan¹⁰⁹ has shown, a **good accounting system** is essential to determine income and justified future expenditures. The establishment of **reserve funds** for improvements to be used in leveling off financial peaks and valleys, as suggested by Siems,¹⁰⁷ is greatly to be desired, but there is often much opposition to the accumulation of the reserve fund.

Papers of Special Interest:

Ironton, Ohio, reduces consumption from 207 to 66 gallons per capita per day by **metering**¹²⁰.

Value of **meter testing** established in Danvers, Mass., Esty,¹¹¹.

Water Rates and Regulations VI, (Questionnaire Compilation)⁷.

Legal aspects of **contracting and bidding**, Parker,¹¹⁷

Friends among customers through personal contact, Richards,¹¹².

Advertising campaign at West Frankfort, Ills., doubles the number of consumers for water company, Wall¹¹⁴.

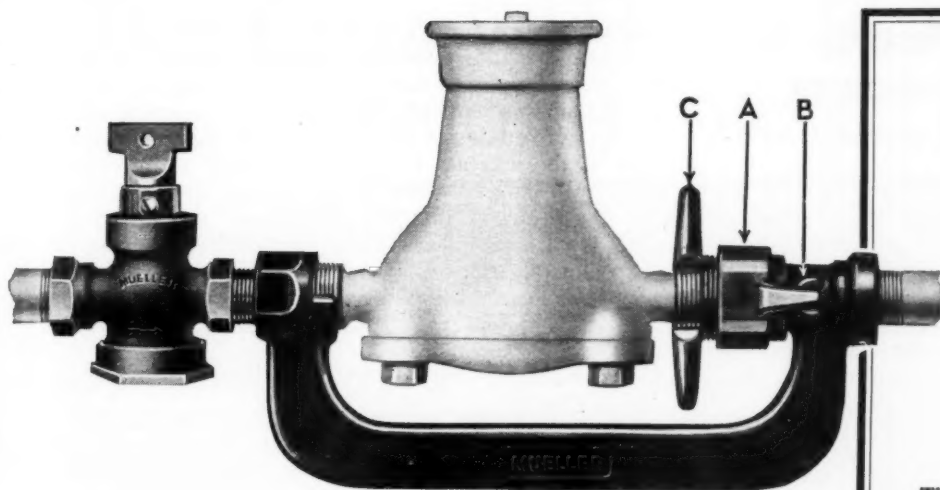
Water Purification

Water supplies in Pennsylvania are much affected by the acidity of streams receiving **mine drainage** and industrial wastes. At the Aspinwall plant of the city of Pittsburgh, Drake⁵⁵ reports that the average alkalinity of the Allegheny river water has dropped from 24 parts per million in 1909 to 5 in 1929. Soap hardness has increased and manganese is annoying. Robert Spurr Weston⁵⁶ discusses the presence of **manganese** in waters. He finds aeration and surface contact with accumulations of the hydrate and organisms on filters and tricklers, effective in removing manganese. In soft water areas Weston does not favor the use of alkalies to precipitate the manganese. In commenting upon this paper, Charles P. Hoover said that in plants where hard water is softened by lime the manganese is completely removed.

More attention is being given to removal of **odors and tastes** than ever before. During the recent low water period taste troubles have been accentuated, though they did not everywhere reach the aggravated stage which Tisdale⁶³ describes in certain West Virginia supplies. At the present time the use of the
(Continued on page 56)

NEW!

MUELLER . . . Straight-Line Water Meter Yoke



**NEW,
Improved
Expansion
Connection**

BETTER THAN ORDINARY UNION COUPLINGS ECONOMICAL TO USE IN REPLACING THEM

This new Straight-Line Water Meter Yoke meets the demand for a simple, sturdy and effective setting for meter box installations and basement settings. A distinct improvement over ordinary union couplings, it saves time and money on the job because of these 4 exclusive features:

1. It acts as a spacer when putting in the meter;
2. It permits the meter to be put in or removed quickly and easily, any time;
3. It braces the pipes when the meter is out;
4. It provides *positive means of preventing the use of water without the company's knowledge*, when the expansion connection is removed.

Because of the simplicity of its design, the Straight-Line Water Meter Yoke can be sold at a price which permits its economical use in replacing ordinary union couplings.

MUELLER CO. (Established 1857) *Factory:* Decatur, Illinois. *Branches:* New York, Dallas, Atlanta, Los Angeles, San Francisco, Chicago. *Canadian Factory:* MUELLER, Limited, Sarnia.

The expansion connection of the Straight-Line Water Meter Yoke is also new in design, incorporating several distinct advantages. Note them in the above illustration, as follows:—

Brass Sleeve (A) is locked to yoke by hook (B) which prevents it from turning forward when meter is being removed;

The Spindle (C) is equipped with two prongs for hand tightening or for greater leverage with MUELLER Multiple Wrench or 1/2-inch nipple.

The expansion connection has only two leather gasket joints, and these are tightened automatically when the meter is tightened in place. The connection may be left attached or removed instantly, as desired.

MUELLER

Trade-mark Reg. U. S. Pat. Off.

Write today for complete information about the new MUELLER Straight-Line Water Meter Yoke and other Waterworks Specialties

HIGHWAYS

and

PAVEMENTS



Permanent Connections for Mudjacking Pavement

By W. E. Barker

AT one point the Mount Vernon Memorial Highway, recently built by the U. S. Bureau of Public Roads to connect the city of Washington with Washington's old home, crosses marshy land where a clay fill of from one to 20 feet and 300 feet long was necessary. To provide against possible settlement of the fill, or of the marshy soil beneath, provision was made in the construction for raising the slabs by "mudjacking" if settlement occurs.

This consisted of building in the concrete pavement pieces of ordinary black iron pipe 6½ inches long, set vertically, to which is attached a galvanized connection with inside threads, the two making a length equal to the depth of the slab. To hold the pipe vertical while concrete is being placed, a steel pin slightly smaller than the pipe is driven into the subgrade and the pipe is placed over the pin. After the concrete is in place the pin is removed with a tool developed for that purpose and is reused. The galvanized plug is then screwed into the pipe as a cap, the top coming flush with the surface of the pavement.

The 40-foot highway is divided into four traffic lanes, the inside lanes 9 feet wide and the outer lanes 11 feet. In the 9-foot lanes the pipes were placed 10 feet apart, beginning 5 feet from transverse joints. In the 11-foot lanes the pipes are staggered, double lines being installed 15 feet apart longitudinally and 5 feet transversely.

If the slabs ever need to be raised, the hose of a mud jack will be attached to the pipes and mud will be pumped under the slabs until they are brought up to their original position.

The installation of the pipes and their spacing is an experiment. Only actual use, if that becomes necessary, will indicate whether or not a closer spacing is desirable.

The use of the mud jack through pipes installed during construction opens up new possibilities for the

construction of rigid pavements over newly made fills or ground that is expected to settle. In the past such fills have frequently been covered by temporary pavement that was removed and replaced by concrete after danger of settlement had passed, with the consequent loss of the original investment, as well as inconvenience and danger caused by an uneven surface. Concrete may now be laid in such locations and raised, as settlement occurs, so that the pavement is kept reasonably smooth riding and safe, and the cost of the temporary surfacing be saved.

Rolling Highway Embankments

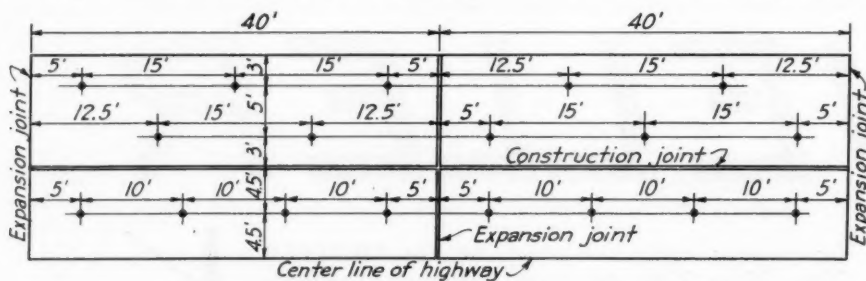
Results of experiments in connection with an investigation in compressing materials such as are used in various embankments throw interesting light on embankment compaction. These results were obtained through the use of a piston acting on the test material contained in a cylinder. The data obtained from these experiments show the necessity for the proper compaction of embankments is, of course, the roller.

Shrinkage Under Pressure

12-in. course—640-lb. pressure per sq. in.		
Dry clay	2½ in.	21%
Damp clay	2¾ in.	27%
Loam	3¾ in.	32%
Stone screenings	¾ in.	7%
320-lb. pressure per sq. in.		
Dry clay	2 in.	17%
Damp clay	2¾ in.	16%
Loam	2¼ in.	19%
Stone screenings	¼ in.	2%
6-in. course—640-lb. pressure per sq. in.		
Dry clay	2 in.	33%
Damp clay	1¾ in.	27%
Loam	2¼ in.	37%
Stone screenings	¾ in.	10%
320-lb. pressure per sq. in.		
Dry clay	1 in.	17%
Damp clay	1½ in.	18%
Loam	1¾ in.	31%
Stone screenings	¾ in.	6%

The most common and widely used implement for compaction of embankments is, of course, the roller. Many types of roller are manufactured, the most common type being the 3-wheel power driven machine. The material on which it is used must be suitable for this type of compaction, the layers thin enough and the roller operated over the entire layer a sufficient number of times.

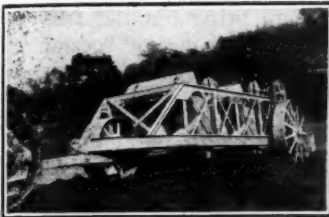
Many state highway department specifications require that the embankment be rolled with a 3-wheel power driven roller, weighing not less than 10 tons. There is no mention in many of these specifications of the required weight per lineal inch width of tread. The result is that in many instances rollers are



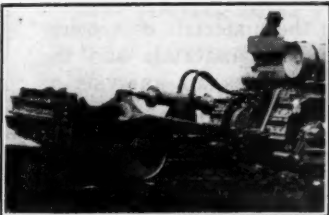
Location of mud jack pipes in Mt. Vernon Memorial Highway

MOST CONTRACTORS WOULD LIKE TO REDUCE DIRT MOVING COSTS AS MUCH AS 50%

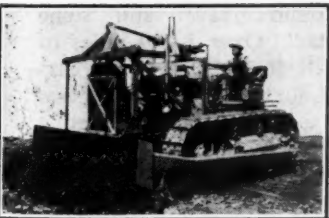
They Can **WITH A BLAW-KNOX
(ATECO) HYDRAULIC SCRAPER**



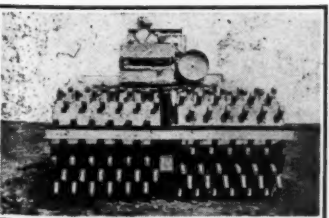
WAGON GRADER



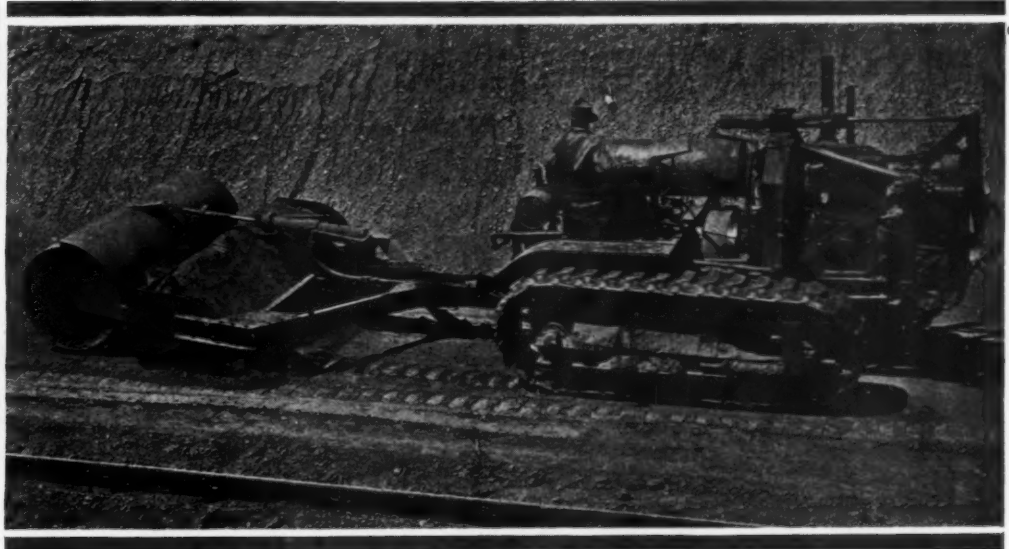
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BULLDOZER



TAMPING ROLLER



How's that for economy?

Hitched to a tractor—the Blaw-Knox (Ateco) HYDRAULIC SCRAPER moves heaping loads, grades, excavates, fills and compacts. Contractors who are using it are constantly adapting it to new cost-reducing stunts.

The HYDRAULIC SCRAPER fits in on all scraper operations—it takes care of those bothersome jobs like fine grading, or close cutting, or spreading the load over the edge of a fill—and it can be used as a Bulldozer.

The all-around utility of the HYDRAULIC SCRAPER has been proved on hundreds of jobs.

Blaw-Knox will show you how to SLICE
your dirt moving and grading costs.

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KNOX

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Send me complete information about the Blaw-Knox
Dirtmover and the complete line of Blaw-Knox (Ateco)
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Company _____

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being used that meet the specification requirements of 10 tons, but with a compression per lineal inch width of tread of only 140 to 150 lbs., while for complete compaction it should usually be approximately 400 lbs. per lin. in. width.

Another type of roller which is extensively used in the far west is the "sheep's foot roller." This is a cylindrical roller about 36 in. in diameter studded with tamper feet 7 in. long. It is built up in sections 48 in. wide with 112 tamper feet per section. The weight on each foot is approximately 665 lbs., and this may be increased to 1,080 by filling the cylinder with water. Each foot contains an area of 6 sq. in. —From report of Committee of American Road Builders' Association.

Albany, California, Makes Asphalt Distributor

The Bureau of Public Works of Albany, Calif., uses for spraying asphalt oil an outfit built at the corporation yard, using a used tank truck purchased from the Standard Oil Company and a new gas engine and pump made by the Fairbanks Morse Company, with some machine work done at a garage in Berkeley.

The tank has a capacity of 350 gallons. The gas engine is a $1\frac{1}{2}$ h.p., and the pump a type "Z" No. 1 rotary. The engine speed is 750 r.p.m., geared from 3 in. diameter to 6 in. gear on the jack shaft, and from a 3 in. gear on the jack shaft to 10 in. gear on the pump, giving a pump speed of about 100 r.p.m. By gearing the engine in this way, reserve power is available for pumping cold bitumuls and it is unnecessary to use a larger engine of double the weight.

Sprockets are hooked up with a $1\frac{1}{2}$ in. silent chain to the pump sprocket which operates with a clutch on pump shaft. The clutch was made from a Chevrolet second and high gear with sliding keyway on shaft, which meshes into a small gear keyed to the 10 in. diameter sprocket on the pump which operates with a throw-out lever.

The asphalt is pumped out of the tank through a hose to a hand spray. When this is shut off, the oil bypasses back to the top of the tank—circulating the oil keeps it from getting thick and clogging the spray.

The total cost was about \$325, which includes all machine work and parts.

For the above information we are indebted to Ray H. Cooper, assistant superintendent of streets.

Investigation of Tar Roads

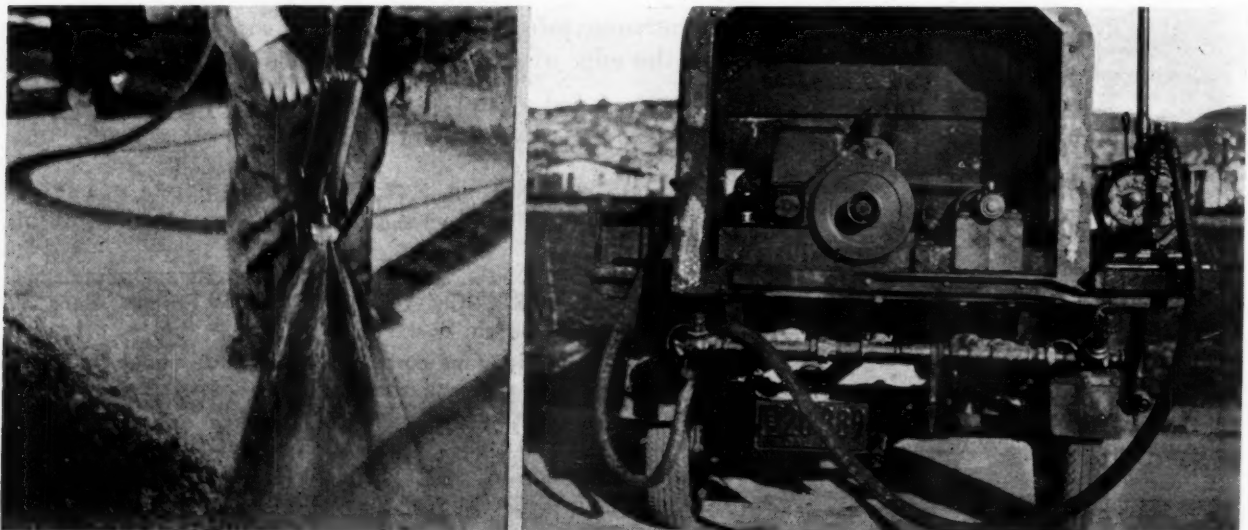
In cooperation with representatives of the tar industry, the Bureau of Public Roads is conducting an investigation of low cost and secondary roads on which tar was used in construction and maintenance. A committee of three was appointed to represent the producers of tar, and an engineer was assigned to work directly with members of the bureau staff in making the study. Work on the project was begun in the early part of this year.

The procedure adopted involves (a) a preliminary survey of the type of road selected for study, and (b) a detailed study of a limited number of road projects. The preliminary survey serves to bring out the factors which should be given attention in the special study. Roads are selected which afford an opportunity to investigate all such factors.

The detailed study of each project involves a complete investigation of the methods employed in construction, the materials and proportions used, maintenance of the road, and its surface condition. Samples are taken to determine the thickness and condition of the mat. In addition to the field work, exhaustive laboratory tests are made on the materials composing the mat, as well as on the base materials and the subgrade. The study also includes an analysis of the costs of construction and maintenance. Information regarding the volume and character of the traffic, if not available from other sources, is obtained in the course of the field work.

Since the beginning of this investigation early in 1931, a survey has been made in North Carolina of sand-clay, topsoil, traffic-bound gravel and stone roads, surface-treated with tar. Over 1,000 miles of such surfaces have been built in the past few years and an extensive program of surface treatment is now in progress. The survey has been completed and a report is now being prepared.

A second survey, covering tar-bound roads in Pennsylvania is now (November 1st) under way. The preliminary survey has been completed and the de-



Albany's Asphalt Distributor. Right, close-up of the machine and left, working the hand spray.



AVOID

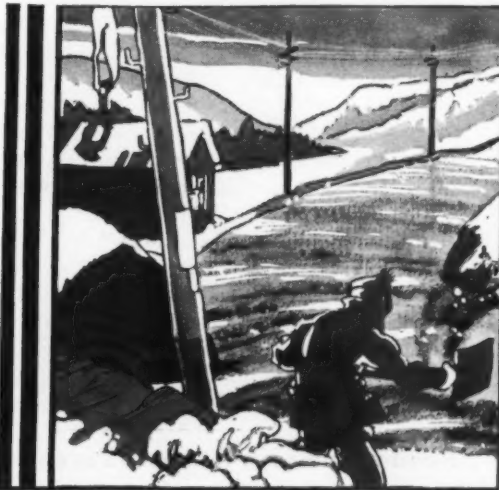
DANGEROUS ICE ACCIDENTS

Provide traction on dangerous, ice covered hills and curves right after the ice forms and you will prevent many serious accidents and the loss of life and property. Coarse sand, gravel or cinders treated with Calcium Chloride will dig in and give immediate traction.

No more practical means can be had than the use of coarse sand, gravel or cinders saturated with a Calcium Chloride solution. Many localities place stock piles of these tractive materials near the danger spots ready for use when the cold weather comes. The piles are thoroughly soaked with Calcium Chloride solution which also keeps them from freezing.

When spread on the ice each particle, due to its Calcium Chloride coating, will thaw enough ice to partially imbed itself. Neither wind nor traffic can dislodge these firmly anchored materials. Bus stops, street intersections and railroad crossings are also danger spots at which many accidents can thus be avoided.

Where solid ice accumulates, such as at drains and culverts, it can be melted quickly by spreading flake Calcium Chloride on it direct. Further data on this timely subject will be gladly given you. Just send the coupon.



Calcium Chloride Publicity Committee

CALCIUM CHLORIDE

"makes ice safe for traffic"

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Without obligation please send complete data on the use of Calcium Chloride for ice traction purposes.

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tailed study begun. In addition to a study of low-cost surface treatments, the Pennsylvania work includes an investigation of tar-bound macadam construction. Surfaces of this type consist generally of a layer of aggregate $1\frac{1}{4}$ inches to $\frac{5}{8}$ inch in size spread to a loose depth of about 3 inches, penetrated with a cold application of tar, and compacted by rolling or by traffic.

In the Pennsylvania study it will be possible to investigate old as well as new work, thereby obtaining information on the effect of changes in methods and materials over a period of years. Following the completion of the work in Pennsylvania it is planned to extend the investigation to different parts of the country, and to study other types of construction which have proved their worth and might with advantage come into wider use. Information of value derived from these studies will be published in the form of progress reports as rapidly as possible.

Pavement for Traffic Tunnel

The Board of Transportation of New York City constructed last summer an experimental pavement built with a view to selecting a pavement for a vehicular tunnel, the traffic conditions being such that the wheels of a very intensive traffic will all be confined to tracks not more than two feet wide and a pavement being desired which can be repaired with a minimum interruption of traffic.

Four kinds of surface are being tested in East Kingsbridge Road, Route 106. All are laid on a 9-inch concrete base. Three of these sections are made of filled steel grating and the fourth is a standard modern brick pavement. The idea of the grating is to bind the paving into a slab 8 feet long and 2 feet wide. These slabs will be laid in the wheel track. When repairs become necessary new slabs can be made outside of the tunnel and quickly interchanged with the old slabs with practically no interruption of traffic.

Section A, 60 feet in length, is a Trilok grating, 3 inches in depth with $2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{7}{8}$ vitrified brick filler blocks set in cement mortar.

Section B, 60 feet in length, consists of vitrified paving brick $3\frac{1}{2}$ inches in depth, 4 inches in width and $8\frac{1}{2}$ inches in length, laid on a cement sand cushion of one-inch depth and filled with asphalt.

Section C, 30 feet in length, is Trilok armoring, 1 inch in depth with 2" openings filled with concrete.

Section D, 30 feet in length, is Kerlow riveted armoring, $1\frac{1}{4}$ inches in depth and filled with concrete.

The field work was in charge of A. J. Mayell, assistant division engineer; T. V. Hayes, section engineer; G. H. Seidenberg, assistant engineer, all of the Board of Transportation.

Reinforcement in Concrete Pavements and Bases

(Continued from page 18)

steel, usually taken as 20,000 lbs. per sq. in. for bars and 25,000 lbs. per sq. in. for wire as used in fabric.

"c" is the coefficient of friction of the concrete slab on the subgrade soil (usually taken as from 1.0 to 2.0).

Regarding the value of "c," A. T. Goldbeck, reporting on tests made by the Bureau of Public Roads (about the only ones made for determining this), said: "These tests seem to show that the coefficient of friction varies between the approximate limits of 1.0 and 2.0. No doubt there is a possibility of its exceeding 2.0

under extremely rough subgrade conditions, but for purposes of design under normal conditions a value of 2.0 may be considered as safe and conservative."

Design of reinforcing is based on a minimum movement over the subgrade, since it has been shown to be more economical to install frequent joints than to use large amounts of steel over a long slab length. In Goldbeck's tests, for movements of .001 inches and .01 inches, with the exception of a subgrade material composed of concrete, no value for the coefficient of friction equalled or even approached a value of 2.0. For the movements above, on both damp and saturated soils of all types, the values of the coefficient varied from 0.16 to 1.29. For larger movements, such as 0.05 inches, the coefficients on soils varied from 1.0 to 2.07. So that, even with a large movement, the highest value observed was 2.07 (on a firm, damp clay subgrade).

Experience based on observations of concrete pavement service has indicated that a value of 1.5 is generally sufficient on ordinary earth soils. This value undoubtedly varies with different soils, with soil moisture content, with degree of compaction and possibly with the consistency and aggregate type of the concrete. In view of these variables, it appears as logical to use a value for the coefficient indicated by pavements in service, as to arbitrarily adopt a test value which will seldom be duplicated in the field.

Practical Design Considerations

The above formula gives us the cross sectional area of steel required for one foot length or one foot width of slab. This requirement might be met by using either a few large members at rather wide intervals, or small members at frequent spacings. Completed research has shown that a greater reduction in cracking may be afforded by small steel members closely spaced than by larger members more widely spaced. This is one of the primary conclusions of the well known nationwide reinforcement survey by C. A. Hogentogler, and has been generally accepted by design authorities. Thus it appears desirable to space the members as closely together as is consistent with manufacturing limitations and with good construction workmanship in obtaining an embedded concrete safe from segregation and honeycombing. A minimum of 4" spacing seems to meet these requirements, but usual practice is to use a minimum spacing of 6" with a maximum spacing of 12".

Rather than conform strictly to the limitations of the formula given, which involves assumption as to a coefficient of subgrade friction and selection of an allowable unit tensile stress in the steel, it may appear quite as feasible and practical to make an arbitrary selection of the distribution and amount of steel as based upon the successful practice of cities, counties, or states which have long used reinforcement. Briefly, this experience has shown that a spacing of 6" for the longitudinal members and 6" or 12" for transverse members, with a total weight of reinforcing from 40 to 70 lbs. per 100 sq. ft., will give excellent results. The relation between the weight contained in longitudinal and the weight in transverse members is generally somewhat the same as the relation between the length and width of slab.

In city paving, where the slab widths (connected by tie bars in bond) and the length between transverse joints are often about the same, general practice is to use the same size members throughout and space the members the same distance apart in each direction, thus making a square mesh—with equal

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"CATERPILLAR" Tractors say "go" to the snow—and "go" to traffic! Powerful plows smash highway drifts; street-sweeping brooms clear city roads and sidewalks. "Business as usual" rewards communities which invest in adequate snow-removal equipment. "Caterpillar" traction conquers slippery ice—"Caterpillar" power licks deep drifts—"Caterpillar" nimbleness keeps ahead of the storm.

Prices—f. o. b. Peoria, Illinois

Equipped for Snow Work

TEN	\$1490
FIFTEEN	\$1855
TWENTY	\$2335
THIRTY	\$2950
FIFTY	\$4390
SIXTY	\$5050

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

Track-type Tractors Road Machinery

Combines

(There's a "Caterpillar" Dealer Near You)



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effective area in each direction. This design proves itself especially practical when intersections or slabs of odd shapes are being placed. Square mesh designs are usually used with a spacing of 6" by 6" for wire fabric reinforcing.

Where slabs of standard highway lane widths such as 8', 9', or 10' are being placed, it is common practice to provide a greater concentration of steel along the edges of each lane than is used in the interior portion of the slab. By keeping the same spacing of longitudinal members throughout, this may be accomplished by using several members along each side of the fabric sheet or welded mat, of larger size than those in the central portion of the sheet. This type of design, called the "heavy-edge" type, is extensively used in pavements of the thickened edge design.

Joints. The design of reinforcing and joints is closely interrelated. The most effective use of joints is predicated upon the use of well distributed reinforcing of proper design; and similarly, most effective service of reinforcing requires a consideration of joint design and spacing. In general, it has been found that a slab length between free transverse joints of from 40 to 60 feet is most advisable. These joints may be of either the expansion type throughout, or expansion joints may be interspersed with joints of the contraction type. Bonded reinforcing should be discontinued at all expansion joints and, as a rule, should not continue through transverse contraction joints.

Location of Reinforcing in Slab. Since the primary purpose of reinforcement is to prevent wide cracks in the surface of the pavement or the concrete foundation thereof, it appears advisable to locate the reinforcement as near as possible to the top surface in order that it may have its maximum efficiency. It has become general practice to place it about 2 inches below the top surface, in which position it undoubtedly is most effective and is most easily installed.

Laps. In general, the required lap for fabricated reinforcing with welded intersections should be such that cross members should pass each other by an inch or two. The definite anchorage or "dead man" effect of the embedded cross members with positive welds at all intersections of the members being lapped usually permits the development of the full tensile strength of the steel at the lap, without necessarily providing a long length of lap. In case welded cross members do not pass each other in making the lap, then a lap length of 40 diameters for plain and 30 diameters for deformed members should be required. With welded wire fabric, cut according to usual manufacturing practice, an adequate end lap may be generally accomplished by using a length equal to the spacing between transverse members; that is 6" where spacing of transverse members is 6", and 12" where transverse members are 12" apart.

Methods of Installation. The choice of a proper method of installing reinforcing involves a consideration of accurate positioning of the steel and the economy and speed with which it can be installed. Only sheet or mat reinforcing wherein crossing members have been welded at all intersections is considered here. Basically, there are two methods of installing fabricated reinforcement; first, by supporting the steel in its proper position by means of accessory devices of some kind, so that the concrete may be deposited through the open spaces between reinforcing members; and second, by depositing the concrete in two layers, the first layer being struck off at the

proper elevation to serve as a supporting bed, on which the reinforcing sheet or mat is spread.

The essential requirements of any method adopted, from the standpoint of quality, speed and economy, may be summarized as follows:

First—The method must guarantee that the reinforcing members are properly and securely placed in their designed position in the slab; and should not permit undue bending of the steel members.

Second—It must permit the placing of the reinforcing in such a way that the rate of paving will not be delayed, even at maximum mixer output.

Third—It must require a minimum of labor and special equipment.

Fourth—It must be easily adaptable to the numerous situations arising in roadway or street paving.

Fifth—The use of it must not interfere with subgrade work or the placing of joints, dowels, etc., and must not promote segregation of concrete aggregates or honeycombing, nor induce planes of lamination in the concrete.

Various devices have been developed to support the reinforcing above the subgrade so that the concrete might be deposited through it, in the form of pins, chairs, overhead cross bars with hooks, and so-called sleds. Each of these devices has shown certain undesirable features, in failing to adequately support the reinforcing, tending to cause paver delay in one way or another, or in promoting planes of lamination in the concrete.

A comprehensive study of all known installation methods, fully substantiated by experience, indicates clearly that, of all the methods tried, the strike-off method, whereby the concrete is placed in two successive layers, is the most desirable method.

Where the paving job is being placed in standard widths and is being screeded from forms or curbs, the use of an intermediate strike-off template sliding on the forms has proved very desirable. This template may be pulled ahead to make the intermediate strike-off by hand, or by cables attached to a power shaft on the mixer, or by any motive equipment available on the job. Where a finishing machine is used, a hinged plate may be attached to the screed board of the finisher and this plate may be let down to make the preliminary strike-off, or cables from the strike-off template may be run forward to a suitable pulley anchorage and then back to the framework of the finishing machine, which pulls the strike-off template ahead by backing up.

Where wide streets with varying crowns are being paved, and at intersections, it is customary to screed the final surface from grade-pegs. In this case, the concrete may be deposited on the subgrade to within 2" of the concrete surface grade and struck off by hand shovels, lutes or other devices conforming to the existing plan of procedure. By designing the reinforcing sheets or mats of convenient and proper length and width, such installation will not tend in any way to promote paver delay and will require but a small amount of labor for the installation work.

The strike-off method as a basis plan of procedure has been proved applicable to every conceivable type of paving job. The exact method of application should properly be dependent on the individual characteristics and organization details of any particular project. With proper planning and job organization it will be found best from the standpoint of effective installation, high speed production and economical construction costs.

Illinois Resurfaces 63²³/₁₀₀ MILES WITH BRICK

ILLINOIS began a brilliant chapter in highway economy this year, by widening and resurfacing worn concrete roads with brick.

A total of 63.23 miles constituted the initial program.

Thus, slabs that have not too far approached the end of their usefulness are being saved for many years to come. *Brick* pavements built 30 and 40 years ago are in constant use today, although not nearly so well constructed as these Illinois brick resurfaced sections.

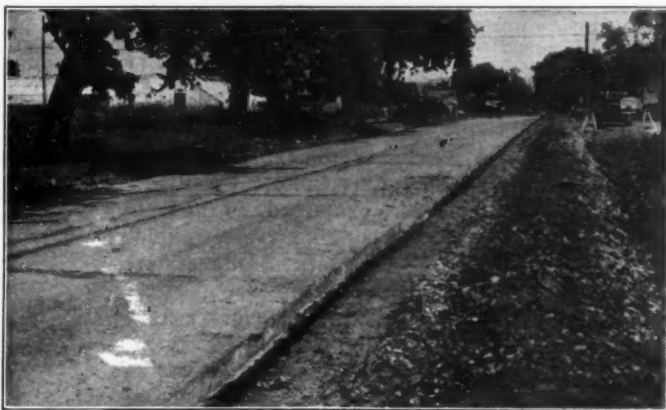
The economy and sound judgment in resurfacing with brick is apparent. The worn concrete—unsatisfactory as a pavement—will make a good base on a subgrade that has received its full settlement. Mastic cushion and bituminous filled brick surface prevent transmission of cracks. Weather and traffic will have no effect on the brick surface. The existing slab has been transformed into a low-maintenance road extraordinarily well suited to all traffic.

Highway engineers, officials and taxpayers will find much of interest in this Illinois work.

Further information on resurfacing with brick may be had by addressing the National Paving Brick Association, 1245 National Press Building, Washington, D. C.



Completed brick resurfacing of worn concrete by Illinois State Highway Department on Route 4 south of Springfield. This gives the highest type highway at low cost.



Worn slab being prepared for curb and brick resurfacing.

Photos by courtesy of Division of Highways, State of Illinois

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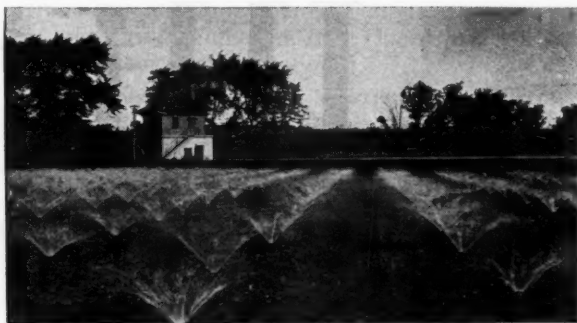
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Sanitary Engineering



Precautions Against Sewer Explosions in Ottawa

OTTAWA, Ontario, early in 1931 experienced an explosion which damaged several thousand feet of sewer, and F. C. Askwith, works commissioner, spent several months following that studying the cause and method of preventing a recurrence. In September he reported to the Ottawa Board of Control that 3800 feet of new reinforced concrete top had been placed on damaged brick main sewers and 880 feet of reinforced concrete pipe had been laid where a section of segment tile intercepting sewer had been destroyed.

Provision had been made for erecting a new sewer ventilating stack at the junction of two intercepting sewers. Several manhole heads were raised slightly so ventilating holes in covers would not stop up, and in 185 others unperforated covers were furnished with ventilating holes. An old gas main was replaced with a new one, and one that passed through a manhole was relocated around it.

All sewers over 12 in. in diameter have been cleaned and the smaller sizes flushed—a total of 175 miles. The seven sewer outlets are inspected once a week and inspections of sewers are made regularly, particularly in the area affected by the explosion. Also 158 gasoline service stations, 69 cleaners' and dyers' premises and 52 laundries were examined, 193 private drain connections inspected and 420 private troubles investigated, and the 2,231 manholes in the system have been examined, cleaned and repaired.

When a complaint is received of sewer odors, a light truck is sent which carries all equipment necessary for gas investigation and safeguards for sewer inspection staff, such as Jones combustible gas detector, Burrell methane indicator, carbon monoxide indicator, gas masks, life lines, sample containers, such tools as are required, also a first aid emergency kit.

When the presence of gas is indicated by use of instruments, ventilating precautions are taken immediately, and the Ottawa Gas Co. notified at once. In order that results of field tests be confirmed, numerous samples of gas were taken to the Mines Branch, where exact analyses were made by Mines Branch chemists. When samples submitted showed a high content of carbon monoxide, mines officials telephoned immediately and continued tests until analyses were completed, often working overtime in order to furnish results with the least possible delay.

After gas detecting instruments were returned to the sewers branch on May 20 last, until the first of September, 1,345 examinations were made at sewer

manholes, catch basins and water valve chambers. One result of this gas investigation work was the discovery of 13 gas leaks in various parts of the city. These were reported to the Ottawa Gas Co., and in every case leaks were found at or near locations indicated by sewer branch employees.

Arrangements have been made with the fire chief and heads of the various branches of the engineering department to aid the sewers branch in the rapid ventilation of sewers in emergencies. In such cases certain divisions of the fire department will respond under fire alarm orders and engineering department employees will be rushed to affected areas in trucks.

Sterilization of Private Water Supplies

The Louisiana State Board of Health has published, in its Quarterly Bulletin, the following suggestions for cheap and effective sterilization of water obtained from cisterns, wells and other private sources of supply:

To Sterilize Small Quantity of Water

Add one teaspoonful of chloride of lime to 1 pint of water.

Add one teaspoonful of this solution to 2 gallons of drinking water.

Let stand for at least one half hour before using.

One quart contains 256 teaspoonfuls.

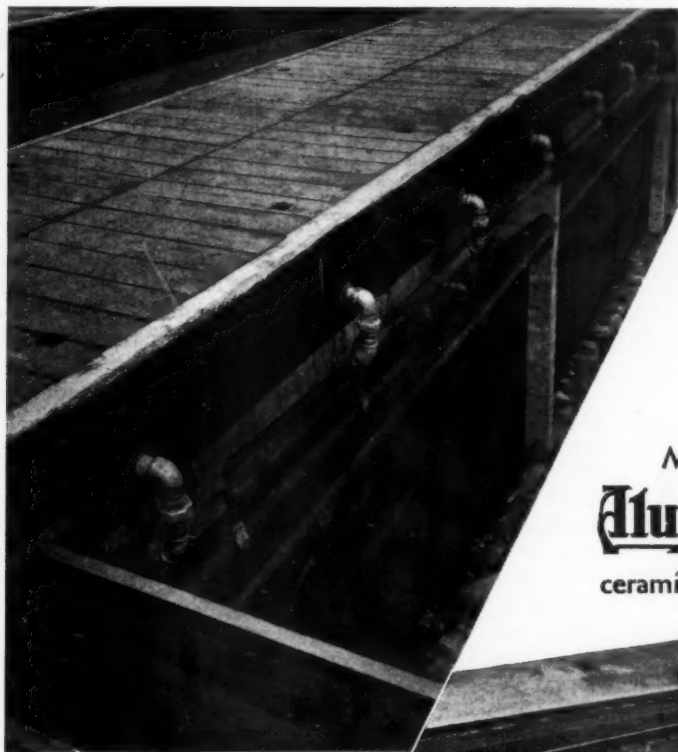
To Sterilize Water in Cisterns

To treat 5,000 gallons of water in a tank or cistern put one ounce of good chloride of lime into a vessel containing about a gallon of water. Shake or stir rapidly for about one minute. Let vessel set for a few minutes so that most of the insoluble part of the lime will settle to the bottom. Pour the solution into the cistern and by manipulation of a board or by the operation of some mechanical device stir the water in the cistern so that the solution will be quickly diffused throughout the volume of water.

To Disinfect Wells

1.—*Drilled and Driven Wells.*—Pump to remove turbidity if possible or lower turbidity so as to make treatment more effective.

Disinfect by placing one-half to one pound of chloride of lime in well, depending on the size of casing and depth of well. The lime should be mixed with a small amount of water to a thin paste, sufficient water added to make about two gallons, and the entire mixture poured into the well. The water level should then be raised and lowered several times to secure as complete distribution as possible, through the water



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Views of a prominent activated sludge plant. Upper:
Close-up showing arrangement of tubes. Below:
General view of tanks in operation.



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columns in the well. The well should be allowed to stand several hours and then thoroughly pumped out.

2. *Dug Wells*.—Treat as above, using one-half pound of chloride of lime.

It should be borne in mind that if the well is not properly constructed and is subject to contamination that the treatment has only a temporary effect. It affects only the water in the well at the time of treatment, and improperly constructed wells may be contaminated a few minutes after treatment.

Wells should have a water tight curb or casing extending from the ground surface to the water bearing stratum, should be tightly covered and water should be drawn only by means of a pump of self-priming type.

Testing a Ten-Inch Well With a Turbine Pump

Accurate information regarding the performance of a well is essential to the selection of the best size and design of pumping equipment for utilizing its flow and to knowing whether it will meet the consumption demands. This can be obtained only by testing the completed well by means of a suitable pump.

The illustrations show the testing of a 10-inch well, drilled and tested by the Keys Well Company, of Ramsey Co., Minn. The equipment consists of a Fairbanks-Morse No. 10 deep well turbine with unit type head and a specially designed vertical speed increaser gear which is adaptable for either direct engine drive or a belted arrangement such as is illustrated. The pump unit rests on heavy wood timbers which also support the pedestals for the counter shaft bearings and the framework for the power units. The entire equipment is easily assembled and dismantled and is adaptable to a variety of conditions.

Perhaps the most unique feature in the entire arrangement is the flexibility in supplying the power to drive the pump, as it is possible to use from one to six power units at any time. This eliminates relying on electric power to drive the conventional type of motor-driven turbine, as it is not always convenient to obtain electric service at the well site. With this type of equipment, the driller can proceed with the development work, or test the well as soon as the drilling is completed. In the illustration, the pump is installed on a 10-inch diameter well which has just been completed and is being pumped at the rate of between 600 and 700 G. P. M. from a depth of 180 feet below the pump base. The pump is being driven

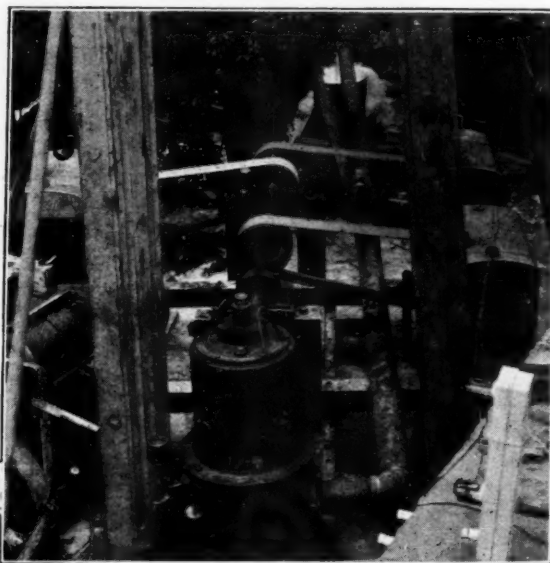
very successfully by three 20 H.P. Le Roi power units. A greater number of power units could be belted to the drive shaft if more power were necessary.

We are indebted to the Johnson National Drillers Journal for the above facts and illustrations.

Gas Explosion in Woonsocket Sewage Plant

In our October issue we described the new activated sludge plant at Woonsocket, R. I. This article had hardly been printed when, on October 2nd, an explosion in one of the tanks killed two of the plant operators.

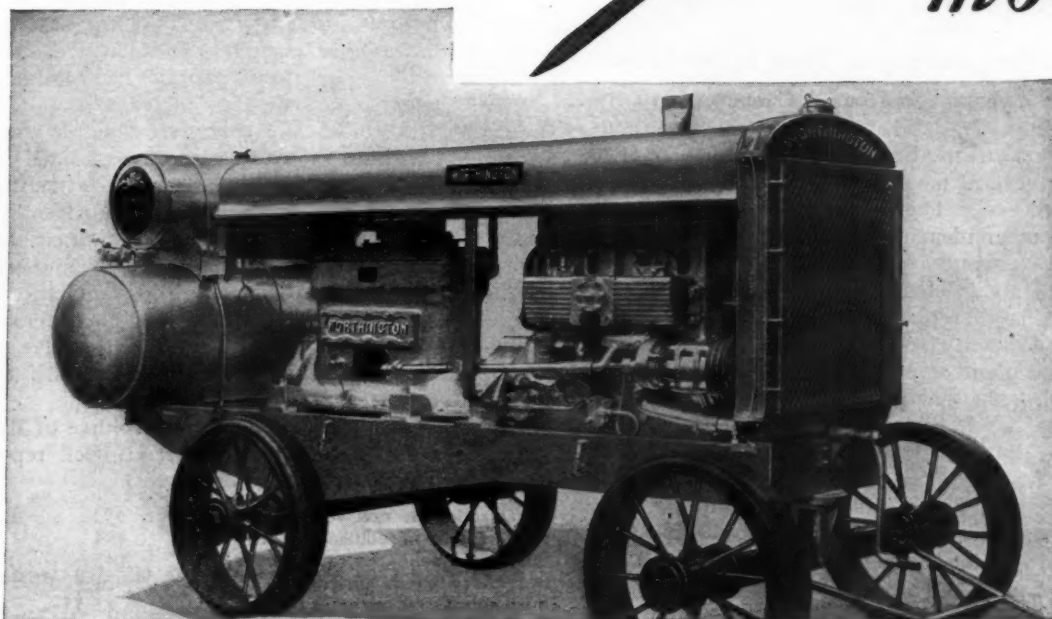
As stated in our article, the sludge is pumped into two three-compartment sludge digestion tanks, which are covered and provided with gas collectors. So far only one of these tanks has been used (the other has been in service about five months) but it was intended to put the other into service and in anticipation of that, digested sludge from the first tank had been transferred to the second to seed it, the valve on the pipe for removing the gas having been closed meantime, but all entrances to the tanks opened to permit escape of gas. On Oct. 2nd two operators entered the tank to inspect the sludge scrapers. One had left when an explosion occurred, which blew the man in the tank up through the entrance manhole, while the one outside was blown into the air and fell back into the three feet of sludge in the tank. Both were killed, and no direct information concern-



10-inch well tested with F-M deep well turbine pump and 3 LeRoi power units.

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moving*



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ing what ignited the gas can be obtained; but as the man in the tank carried no light or steel tools and wore rubber-soled shoes it is surmised that he must have lighted a match for some purpose.

Troubles With Crusts in Pipe Lines

An unusual experience with complaints was encountered in the water system of the California Water Service Company reaching Concord, Martinez, Crockett and Walnut Creek. The trouble is interesting in that it was due to the fact that for many years a very hard well-supply had been used and this caused thick crusts to form in the pipe lines. About March a very soft supply was substituted, derived from the Lower Sacramento River and treated in the new filtration plant at Clyde. This water carried considerable carbonic acid. The result was the sloughing off of accretions in the pipe, which smelled like the coating in a teakettle, and this led to the complaints mentioned. The remedy was simply to pump a small percentage of well water sufficient to neutralize the carbon dioxide in the river water supply.

Cameron's Original Septic Tank Is No More

About thirty years ago Donald Cameron, city engineer of Exeter, England, built a tank designed for a novel method of treating sewage and studied its operation for several months; then described it to his brother engineers. This was the Cameron septic tank, and no other idea in sewage treatment has ever been adopted so rapidly or widely. Mr. Cameron died last May, and his original tank will not long survive him. Exeter is to replace this and its other septic tanks, whose capacity it has outgrown, with an activated sludge plant of much greater capacity.

In describing the new plant before the Royal Sanitary Institute, E. J. Silcock said: "That septic tank (the first one built), together with the contact beds attached to it, has been in constant operation for about thirty years. The working of this tank has been a source of considerable trouble, as the anticipations that the whole of the suspended solids in the sewage would be converted into liquid or gaseous form was not realized. Much expense has been incurred from time to time in removing the sludge from the tanks.

"Apart from this trouble, the contact-bed system of aeration was not satisfactory; furthermore, the site of the works is too near the centre of the city and residential districts have grown up adjoining it. For these reasons it has become desirable that the works should be entirely removed."

Two other similar plants for other districts were unsatisfactory for the same reasons, and it was decided to treat all the sewage from the three districts at a single plant to be built about three miles from the center of the city. This is to be an activated sludge

plant employing the Simplex system, the sewage first passing through detritus and screening tanks with a combined capacity of 3% of the dry-weather flow, and sedimentation tanks having a capacity equal to 8 hours dry-weather flow; the aerating tanks have a capacity double this. The estimated cost, including the land, is about \$400,000.

New Sewage Treatment Plant at Dearborn

(Continued from page 23)

The table below covers analyses of a sewage over a period of approximately ten weeks. Standard Methods of the American Public Health Association for analysis of sewage were used.

Hubbell, Hartgering and Roth, consulting engineers, were retained to review and report upon the results of the experimental work. In this review Mr. Hubbell said, "It would appear that the proportion of paper added does not much affect the removal of suspended solids nor of biochemical oxygen demand. The excessive amount of paper used in test 'B' appears, if anything, to have increased the suspended solids in the clarifier effluent over what they would have been without the use of paper. The biochemical oxygen demand also shows an increase in this test. In general, the biochemical oxygen demand appears to decrease with an increase in the use of lime. The efficiency of ferric chloride in assisting sedimentation was indicated by the increase in suspended solids in the clarifier effluent in test 'K' in which ferric chloride was omitted. Chlorine added in amounts as low as three to five parts per million appears to be very efficient. This is due to the very clear character of the effluent. For Imhoffs, some ten to twelve parts per million would be required to accomplish equal sterilization."

From the tests made to determine volume of sludge to be expected in this process, Mr. Hubbell reported the following data:

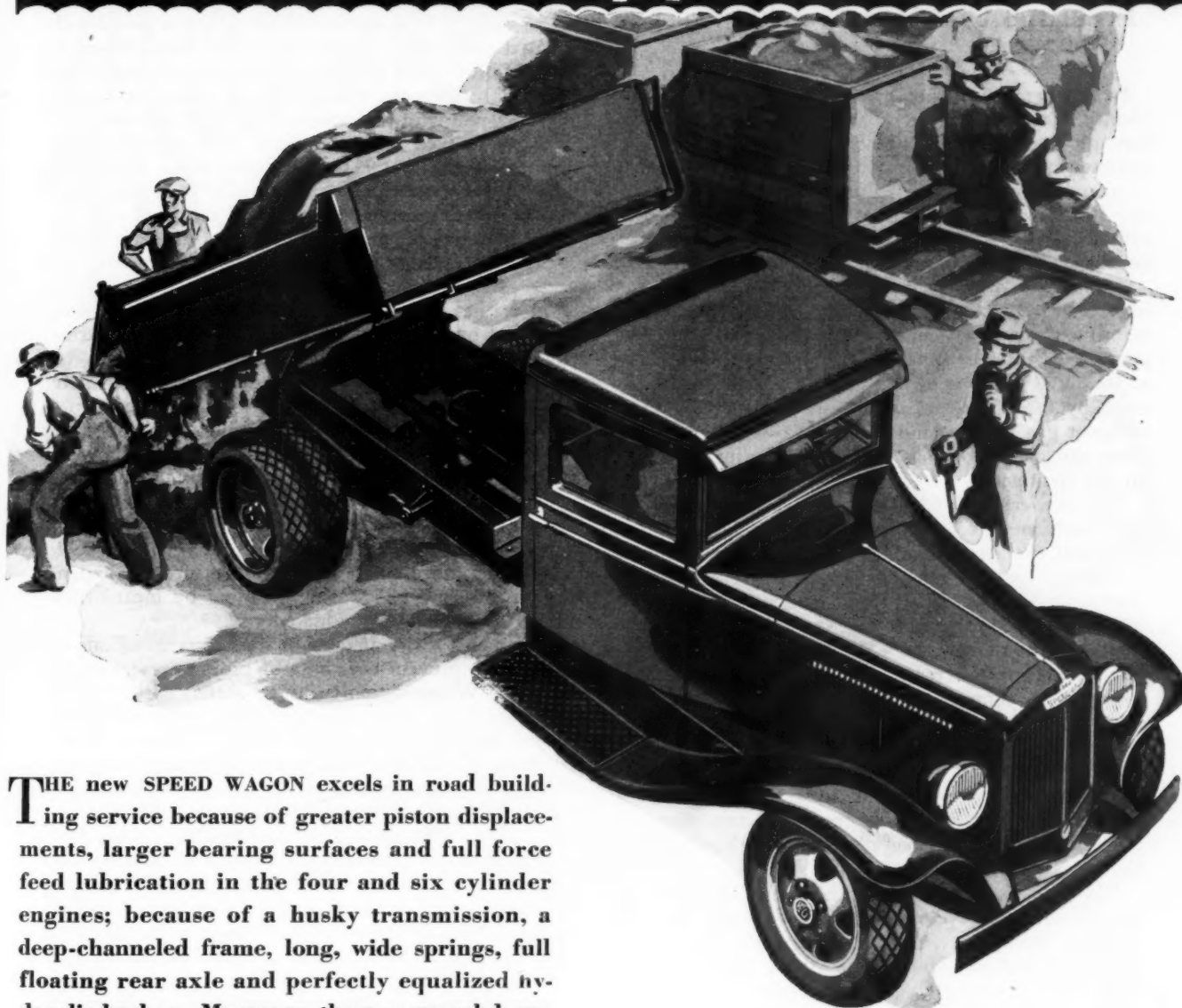
Total solids in raw sewage.....	Avg.	571	P.P.M.
Total solids in effluent	"	494	"
Suspended solids in raw sewage...	"	143	"
Suspended solids in effluent.....	"	21.5	"
Suspended solids removed, weighted	"	85.5%	"
Gallons wet sludge drawn (94.1%)..		4000.0	P.M.G.
Sludge lbs. dry weight.....		1950.0	"
Equivalent 65% cake, lbs.		5560.0	"
Lbs. of lime (62%CaO).....		613.0	"
Lbs. ferric chloride (47%FeCl ₃)...		125.0	"
Lbs. paper 10% moisture		426.0	"

"It will be noted that the amount of sludge obtained by chemical precipitation is about three times that obtained by plain sedimentation. This is due to more complete removal of suspended solids and to the addition of solids in chemicals used."

A comparison of the results of the Imhoff tanks in the old Dearborn plant with the experimental tank,

	INFLUENT			EFFLUENT			CHLOR. EFF.			
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Red. %
SOLIDS										
Total	1550	440	639	790	210	494				23
Suspended	920	45	175	70	10	26				86
NITROGEN										
Ammonia	32	6	15	28	6	14				
Organic	4.8	0.8	2.9	3.6	0.4	1.5				
CHLORIDE	78	28	56	180	44	81				
P. H.	8.4	7.0	7.3	8.4	7.0	7.8				
ALKALINITY	700	70	336	820	140	323				
DISSOLVED OXYGEN	5.3	0	1.1	9.8	3.5	6.9				
B. O. D. 5 day	250	15	100	210	3	55	67	5	33	67
Relative Stability—Days.....				10	.5	3.1	10	1	8.0	

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as far as solids removal is concerned, gives the following result.

	Raw Sewage	Imhoff Effluent	Exp. Tank Effluent	
Total solids	636	542	496	P.P.M.
Per cent reduction..		15	22	
Suspended solids	175	96	23	P.P.M.
Per cent reduction..		45	87	
Settleable solids	1.83	.24	.04	c.c./L
Per cent reduction..		87	98	

Treatment of Gas Works Waste Water

In a paper before the Institution of Municipal and County Engineers, of England, J. S. Pickering, borough engineer of Cheltenham, described a sewage treatment plant which is giving excellent service after 17 years' operation. (See PUBLIC WORKS for September, 1931.) He also described the arrangement made with the gas works for receiving its waste waters in the sewers. Concerning this Mr. Pickering said:

"Since the introduction of vertical retorts at gas works, and the changes that have taken place in the manufacture of gas, many local authorities have experienced a greater difficulty in purifying the sewage at the outfall works owing to its character being altered by the admixture of a more concentrated form of spent gas liquors, and in some cases the discharge from the gas works has had a most injurious effect on the treatment.

"In the case of Cheltenham, the new conditions have been met by co-operation between the gas company and the corporation.

"An agreement with the gas company restricts the discharge of their waste liquor into the sewers to a rate of not exceeding 5 per cent of the average dry-weather flow of sewage. The liquor is stored in a large underground reservoir at the gas works, from which it is pumped to an overhead tank, and discharged at a uniform rate through a V-notch into the sewers. The discharge is automatically recorded on a chart which is forwarded to the author weekly. The rate of flow is invariably indicated on the diagram by a horizontal line below the maximum discharge allowed, which shows that the company are fulfilling the conditions of the agreement.

"If the gas liquor had been allowed to enter the sewers uncontrolled, there is little doubt that the bacterial treatment at the sewage works would have been prejudicially affected to a very serious extent. The solution of the difficulty has been accomplished to the mutual satisfaction of the interested parties, and the author would like to take this opportunity of making particular reference to Mr. L. E. Twycross, the gas company's engineer, to whose valuable assistance the successful results are in a great measure due."

The Water Wheel

(Continued from page 40)

ammonia-chlorine process to prevent development of chlorophenol tastes and to reduce other tastes is receiving study throughout the country. Berliner and Howe⁴ review the literature and chemistry of the process^{4, 61}. Goehring^{65, 119} found the method useful at Beaver Falls and New Brighton, Pennsylvania. Lawrence⁶⁶ found the method effective and economical at Cleveland, Ohio. He did not detect, as did Gerstein⁶², any material **retarding of the sterilizing action**

of the chlorine when ammonia was used with it. The ability to maintain effective residual chlorine concentrations in the mains without causing complaint of odor and taste was found to be desirable. Jordan^{64, 113} used **ammonium sulfate** containing 0.003% phenol with excellent results at Indianapolis.

The use of **activated carbon** for the purpose of adsorbing the odor and taste producing substances has been attempted in various ways. Passage of filtered water through a bed of relatively coarse activated carbon has been found satisfactory at Bay City, Michigan, by Harrison⁶⁷. In numerous other plants a **powdered activated carbon** has been tried^{68, 124}. The carbon is probably best mixed with the effluent leaving the coagulation basins for the filters. This is not always possible, however, and the material has been added to the raw water, mixed with the alum dose, added at the entrance of the water to the coagulating basins or added directly to the filters. Liddle¹⁰¹ reviews the **German practice** in the application of activated carbon.

The material of which **rapid sand filters** are composed has received special study in the last two or three years. A committee of the American Society of Civil Engineers has been at work⁵⁷. Studies have also been conducted by a committee of which James W. Armstrong, of Baltimore, has been chairman. Results of this work indicate that current specifications for **filter sand** require too fine material^{58, 59, 60}. In experiments at Denver⁶⁰ best results were obtained with sand of effective size of 0.60 mm., but even better results were obtained when a combination of sand and crushed and graded anthracite coal was employed. Twenty-four inches of the coal, effective size 0.83 mm., rested on 15 inches of sand with an effective size of 0.50 mm. Gilkison¹²⁷ describes an easy way to measure the **expansion of the sand bed** during washing by means of a submarine light on a graduated rod.

Treatment of the effluent of the filters with lime or soda ash to prevent **corrosion of pipes** is reviewed by Baylis¹²¹. Water which is just saturated with calcium carbonate is in ideal condition. Lime may be added to raise the pH of the water to 8.0 or above. Baylis believes that the **zinc** coating of galvanized iron pipe should not be depended upon for pipe protection when the temperature of the water is above 160°F., since above that point the zinc is corroded with liberation of hydrogen gas. Studies on the effect of velocity and oxygen content of the water on the **corrosion of steel** by Roethli and Brown⁵¹ and by Cox and Roethli⁵² have led them to the belief that when black magnetic oxide of iron can be deposited, its granular nature permits of more rapid corrosion than when gelatinous ferric hydroxide is the corrosion product. Increased velocities of the liquid, up to eroding ones, and increase concentrations of oxygen lead to the formation of the ferric hydroxide and slower corrosion.

Papers of Special Interest:

Purification of water by **Louisiana Steam Products Co.**⁷⁷.

Hot process softening is more economical than evaporator, Yoder⁷⁵.

Greensand water softening zeolites and their preparation, Hungerford¹²².

Canadian National designs **special locomotive** for bad water territory⁸⁵.

Influence of **oxygen content** on boiler scale formation, Groeck³⁹.

Solutions of sodium chloride or sulfate **foam** less in boiler than does distilled water or very dilute solutions

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of these salts, Foulk⁴⁸. Treatment of water in the manufacture of ice, Burks⁸⁶.

Laboratory

Churchill^{50, 60} reports finding of **fluorine** spectroscopically in water suspected of causing **mottling of teeth** of children. The amounts ranged from 2 to 13.7 parts per million, but Churchill thinks the method for determining fluorine gives low results.

Heck⁷⁴ shows that the **compression of water** increases rapidly with rise in temperature. Feed water pumps in high pressure stations therefore consume a substantial amount of work in **compressing liquid water**. Smallwood⁷¹ discusses the **thermodynamics** of high-pressure water.

Articles of Special Interest:

Common causes of **rural well pollution**, King⁴⁹.

German view on the suitability of the **Bacterium coli** as an indicator organism, v. Vagedes⁴⁴.

Measurement of the biologically important portion of **ultra violet light**, Taylor and Holladay⁹¹, Sharp and Little⁹².

Industrial use of **ultra violet light**, Free and Clark⁹³.

Miscellaneous

Articles of Special Interest:

Swimming Pools.

Vancouver, B. C., has a large ocean pool at Kitsilano Beach⁸⁹.

Pool water is satisfactory to German authority if free of Bact. coli in 100 mls., not more than 200 bacteria per ml., residual chlorine 0.1 to 0.5 ppm., and water is clear. Dithorn⁴⁰.

Splash plate aeration used to assist in **removing iron** from water for public bath, Dennewitzstrasse, Berlin, Castner⁴².

The Drought.

Effect of 1930 drought on 1931 **water supplies** special reference to Ohio⁵.

National aspects of the Drought, Hoyt¹¹.

Drought and yield of wells⁴⁵.

Rainfall in England and Wales 17% above normal⁸⁸.

Historical.

History of New England Water Works Association
34. 105, 115

Great hydraulic engineers of New England's classic period, Sherman¹⁸.

Fayette F. Forbes dean of New England water works superintendents²⁷.

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* The Three Leading Articles.
n Note or Short Article.

The American City, Vol. 45, No. 4 (September, 1931.)

n1. Elevated Tanks Take Care of Peak Demands, A. W. Hebring, p. 7.

n2. Water for El Paso Taken from Eleven Wells, Arthur H. Woods, p. 7.

n3. The Aviation Influence in Water Tank Design, Anon., pp. 96-97.

4. The Advantages of the Ammonia-Chlorine Treatment of Water, J. F. T. Berliner and Arthur E. Howe, pp. 102-104.

5. Effect of the 1930 Drought on 1931 Water Supplies, Anon., pp. 105-106.

6. Water Is Not Free—But by Completing a Public Water System a Small Maryland Town Reduced Taxes, T. W. Hacker, pp. 109-110.

7. Water Rates and Regulations, Part VI, Anon., pp. 124-125.

The Canadian Engineer, Vol. 61, No. 14 (October 6, 1931.)

8. Bow Island, Alberta, Water Supply, Anon., p. 10.

9. Purification of Rivers and Streams, J. M. Henderson, pp. 13-15.

10. Gate Valves in Water Works Systems, Seth M. Van Loan, pp. 47-48.

Civil Engineering, Vol. 1, No. 13 (October, 1931.)

11. National Aspects of the Drought, John C. Hoyt, pp. 1167-1171.

12. Old Wood Pipe Stands Severe Test, F. W. Greve, p. 1204.

Dutch Boy Quarterly, Vol. 9, No. 3 (1931.) (National Lead Co.)

13. Painting Standpipes, pp. 17-21.
The Engineer, Vol. 152, No. 3946 (August 28, 1931.)

14. Rand Water Board, Annual Report, pp. 224-225.
Vol. 152, No. 3947 (September 4, 1931.)

15. Carrying a Water Main Across a Bascule Bridge, Anon., p. 244.

Vol. 152, No. 3950 (September 25, 1931.)

16. A New Sand-Spun Pipe Plant, Anon., pp. 322 and 324.
Engineering News Record, Vol. 107, No. 12 (September 17, 1931.)

n17. Siam to Have American Adviser on Water Supply, Anon., p. 465.

Vol. 107, No. 13 (September 24, 1931.)

18. Great Hydraulic Engineers of New England's Classic Period, Charles W. Sherman, pp. 475-479.

19. New Electric Pumping Plant to Supplant Steam Station in Pittsburgh, Ross M. Riegel, pp. 480-482.

20. Factors Governing Arrangement of Modern Pumping Stations, Charles B. Burdick, pp. 483-486.

21. Great Economies Achieved by Modern Pumping Equipment, W. M. White, pp. 486-487.

*22. Water Works Architecture, Victor A. Matteson, pp. 488-491.

23. Water Plant Built at Low Cost Holds Industries in Small Town, Burton Lowther, pp. 492-493.

24. Huge Intake Lagoon Built to Avoid Ice Troubles, Torris Elde, pp. 494-498.

25. Water Distribution System Development an Unending Task, F. H. Stephenson, pp. 499-501.

26. Concord, N. H., Drives 150 Wells to Avert Water Shortage, pp. 501-502.

27. Fayette Forbes, Dean of New England Water Works Superintendents, Anon., p. 503.

28. Modernization of the Distribution System and Its Accessories, H. W. Griswold, pp. 504-507.

29. Tunnel Driving at Cobble Mountain, Anon., pp. 507-511.

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n30. Detroit Uses Temporary Pumping Plant in Summer Months, William C. Rudd, p. 530.

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34. N. E. W. W. A. Reviews Half Century of Waterworks Development, Staff Report, pp. 577-579.

35. Ford Water Tunnel, Detroit (A Letter), John F. O'Rourke, p. 584.

n36. Preliminary Work Begun on Colorado River Project, Anon., p. 585.

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n38. Upper Alameda Creek Dam for San Francisco Water, Anon., p. 595.

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39. Hat der Sauerstoffgehalt des Wassers einen Einfluss auf die Wassersteinbildung? Max Groeck, pp. 514-517.

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42. Die Enteisungsanlage im Berliner Stadtbad, Dennewitzstrasse, Castner, p. 549.

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46. Piping Improvements in Condenser Water Circulating Systems Reduce Cost in Pumpage, Herman Vetter, pp. 835-839.

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54. The Recovery of Lost Drilling Tools, Part III, A. G. Fiedler, pp. 1-2.

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60-Inch Clay Lined Concrete Sewer

(Continued from page 16)

which retarded the production of gas from packing house wastes; or all three of these factors have prevented deterioration above the water line since the 1923 flood. But these other trade wastes have at times been acid enough to attack the concrete below the water line. They are now emptied into the open channel of the drainage canal flowing entirely through the city and thereby creating some nuisance.

It is probable that a separate vitrified clay sewer will be built along the canal at some future date to serve those industries whose wastes react unfavorably on concrete and which cannot be conveyed in an open channel of nearly zero flow most of the time.

Designing the New Sewer

The design of the two intercepts therefore involved the question of structural strength, which can be met so easily with reinforced concrete, and protection from depreciation from trade wastes, which is best answered by the use of salt-glazed vitrified clay products. Depths of sewers to invert are about 15 feet. Soil is sandy loam and clay from 2 to 6 feet deep, underlaid with clean sand which is water bearing at about 12 feet.

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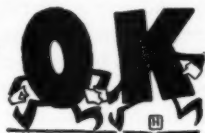
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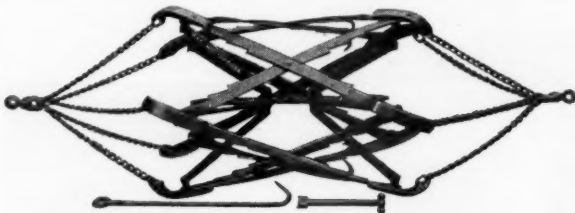
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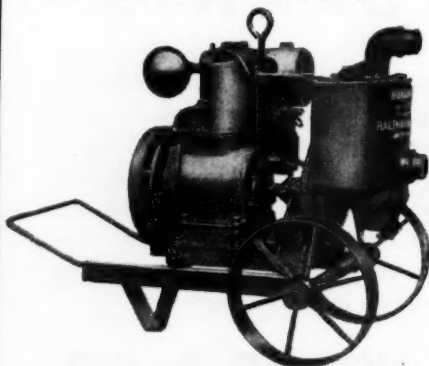
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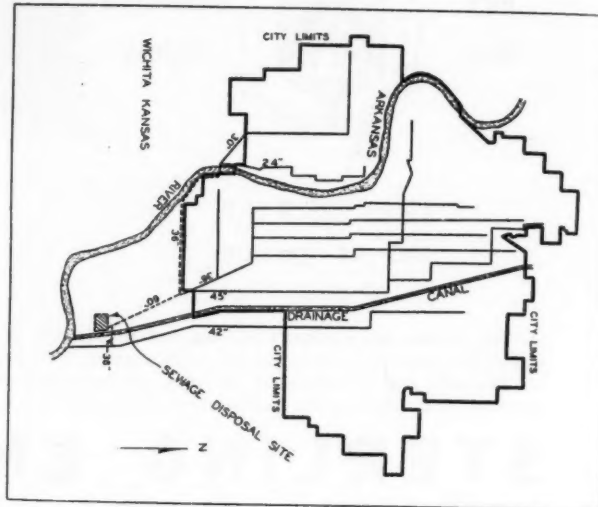
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that basis using asphalt joints. As a matter of information to us and open competition between manufacturers concrete pipe was admitted without cradle, using clay liners in segmental form. Joints between the liners were specified to be one-inch in depth (which is the thickness of the liners), made with either a hot poured asphalt joint material or with some of the recognized asphalt mastic preparations on the market.

It is of interest to note that on the estimated length of 11,270 feet, the lowest bid on this item was \$7.20 per foot completely installed, with a quoted price



Layout of Wichita Sewerage System

of \$4.85 per foot for the pipe on track for vitrified clay pipe. This bid was tied up with other units so it could not be accepted under the terms of the letting. Contract was let for clay pipe at \$7.40, the bids ranging up to \$8.00. The lowest bid on the clay lined reinforced concrete pipe was \$7.50 per foot ranging up to \$8.50.

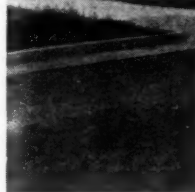
Clay pipe was furnished from four manufacturing plants. Specimen pipe was broken from all plants using the standard sand bed method. Strength ranged from 5,300 to 7,000 pounds per foot.

Joints are poured asphalt, water was kept down by pumping in the open ditch. Infiltration with heads of one to two feet above the flow line is well below the specified maximum of 5,000 gallons per twenty-four hours per mile.

As a further comparison of costs, the 36-inch reinforced intercept to the east, estimated length 1,100 feet, no pumping required, depth the same, no clay liners, was contracted for at \$4.50 per foot installed and the bids ranged from \$4.40 to \$5.60.

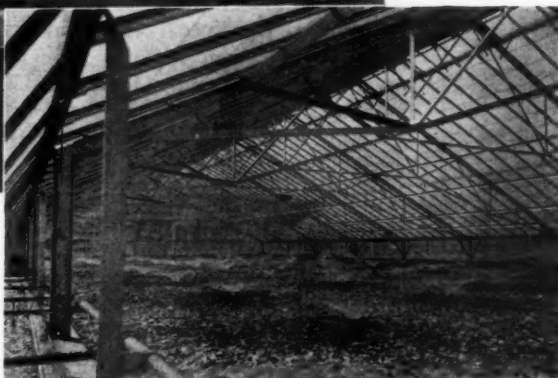
No alternates were specified for the 60-inch sewer. No clay pipe is available in that size, and segment block sewers depend for integrity and strength on the excellence of the mortar joints which our own experience has shown to be subject to attack. We have a number of storm sewers of segment blocks which are giving satisfactory service so that we are not prejudiced against them. It is evident that immunity to attack is an essential item in conditions which have been described and continuous structural integrity is equally essential. This is especially true in the location of the sewer in question. It is adjacent to a railroad through most of its length, subject to vibration from high speed trains with possibility of industrial tracks across it anywhere.

Liners as already described were specified. Design



(Above) Trickling filter cover can be seen on the left. Sludge drying beds on the extreme right.

(Right) Interior of the trickling filter cover.



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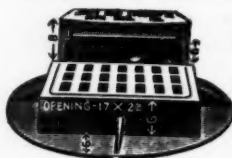
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data for the pipe are those published by the American Society of Municipal Engineers whose committee prepared them jointly with representatives of A. S. T. M. and the Concrete Pipe Manufacturers' Association. Cold drawn steel wire mesh is used and concrete designed for 3,500 pounds crushing strength. The pipe should have a strength on the design data of 12,000 pounds per foot by sand bearing method. No tests of pipe have been made because of lack of facilities. Joints are 5 feet long. Concrete as produced is consistently testing 3,000 pounds or more at 7 days, 4,000 pounds or more at 30 days and 5,000 pounds or more at 60 days. Aggregate is secured from the river bed. About 10% to 15% is retained on a 1/4-inch screen. Grading factor is 3.25 to 3.75. Water used is six gallons to the sack, with a cement factor of eight sacks to the cubic yard. Mixing is two minutes. Aggregate is weighed.

This is not an expensive concrete under our conditions. Aggregate is delivered at 75 cents per cubic yard, and cement is now priced at \$1.46 per barrel. At these prices materials cost \$3.67 per cubic yard.

Pipe is manufactured at a casting yard near one end of the project and is delivered at about \$10.00 per foot. Each 5-foot joints weighs about 4 tons. The contract price is \$14.02 per foot installed complete. Bids ranged from \$13.65 to \$16.40.

The Independent Pipe Company, which is making the pipe, has worked out a very satisfactory routine of installing the liners and making and handling the pipe. They are stripped in twenty-four hours, rolled over in forty-eight hours, and delivered to the ditch in seven days. A mastic joint material is used between the liners, both in the pipe units and between the liners at the ends of the pipe as they are laid. It consists essentially of particles of gilsonite, mixed with short asbestos fiber, which is mixed on the job in measured quantities with a solvent which is varied to suit different conditions of season and use. As shown in the pictures the mastic was plastered on the edges of the liners which were set up around the inside form and the pipe completed in the ordinary way. Steaming in cold weather was done on the outside of the pipe only without affecting the liner joints. A vibrator was tried on the outside of the pipe. It increased the strength of the concrete about 25% in 28 days but forced the asphalt material out of the liner joints to such an extent that it was not continued.

Hooks are not allowed in handling the pipe. There is no unusual difficulty in laying it or securing water tight joints.

We have every reason to believe that the sewer has sufficient load bearing strength to support anything which can be reasonably built over it and that the liners will remain in place and that the asphaltic mastic joints will be acid proof for an indefinite length of time—certainly for thirty years or more. Some doubt has been expressed as to the softening action of oil on the asphalt on the ground that all sewage contains some oil and even some gasoline. Our thought in the matter is that even if the surface of the asphalt should be slightly softened, which is doubtful, there will not be sufficient scouring action to carry it away on our very flat grades and that it will never be softened enough to flow out of the joints at the temperature of the sewers. We feel reasonably satisfied that the additional cost is amply justified and that the three basic construction materials, (clay, concrete and asphalt) are each performing the func-

tion for which they are best suited. Reinforced concrete giving strength, clay properly bonded to it by plenty of ribs on the back of the liners protecting the concrete from its destructive enemies and asphalt sealing all cracks and compensating for the rigid inequalities of the other two materials.

The extra cost is probably one-half more than the least cost of either concrete or clay products alone, but the extra cost and nuisance of rebuilding or repairing a sewer main in service in developed territory is sometimes nearly prohibitive.

Water Purification With Ultra Violet Radiation (Concluded from the October issue)

By J. F. Springer

Other Installations

At the city of Horton, Kansas, a single-unit installation has been made for sterilization purposes. The conditions here are favorable. The water when it reaches the apparatus is ordinarily practically free from turbidity and the current is obtained at cost from a generating plant which is said to be operated efficiently. This was in 1927. The population to be served is around 4,000.

A Tennessee plant was reported in 1927 as existent in the state, the reporter being H. R. Fullerton, director of sanitary engineering of the State Department of Health.

A sterilizing plant was installed some years ago at Henderson, Kentucky. The battery was reported to consist of fifteen units, which were so arranged that the filtered water passed through five units successively. The consumption of current was put at 92.5 kw.-hr. per 1,000,000 gallons. A turbidity of 10 parts per 1,000,000 was found sufficient to make a considerable reduction in effectiveness.

At Henderson, tests were made covering the bacterial content under six different conditions—(1) after filtration, and (2) after the treatment of each of the five successive lamps.

Condition of Water	Number of bacteria per c. c.	B. coli Index
After filtration	32.00	0.260
After Lamp No. 1.....	16.00	0.215
After Lamp No. 2.....	8.00	0.200
After Lamp No. 3.....	6.00	0.136
After Lamp No. 4.....	2.10	0.090
After Lamp No. 5.....	0.31	0.000

Concerning the Perrysburg, Ohio, plant, Robert H. Troyer, assistant superintendent, on April 23rd, 1931 wrote: "Our ultra violet ray plant works very satisfactorily, with very little attention. It is a 6-inch three-lamp outfit and cost \$3,000 installed. The cost to operate (electricity, 24 hours) is about \$1.00 per day. It costs \$125 apiece to replace a lamp. We operate it 24 hours a day. The water is tested every two weeks by a chemist and so far has been O. K."

Foreign Installations

The practical application of ultra-violet radiation to municipal water occurred first in Europe. Before 1915, there were a number of city plants in France: Maromme-les-Rouen (55,000 gallons); Isle-sur-Sorgues (Vauclose) (220,000 gallons); Amiens (3,740,000 gallons); Luneville (1,650,000 gallons); St. Malo (308,000 gallons). These outputs, or capacities, are daily amounts. Current used was direct and varied in voltage from 110 to 250.

A few years ago (about 1924-25), Monaco was

(Continued on page 69)



THE HIGH COST OF "ECONOMY"

Just 20 years ago, the City officials of this town were "economical." "Cast iron pipe costs too much," they said. So they paid less per foot for a pipe that has now cost them *more per year* because it did not last.

So this time, when they replace their short-lived pipe, they are laying everlasting cast iron pipe. *It* will never have to be replaced, for cast iron cannot rust or rot.

CAST IRON COSTS LESS

Cast iron pipe is now at a very low cost per foot as well as per year. Never will there be a better time to install it. And while you are getting cast iron pipe why not get McWane—the modern pipe plus the advantages of the time-tried sand-casting principles.

Get the facts on smallest sizes too—down to 1¼ and 2 inches—when you buy McWane cast iron pipe. New booklet for the asking. Ask.

Pipe sizes: 1¼ thru 12 inches. Lengths to 16 feet in sizes above 3 inch.

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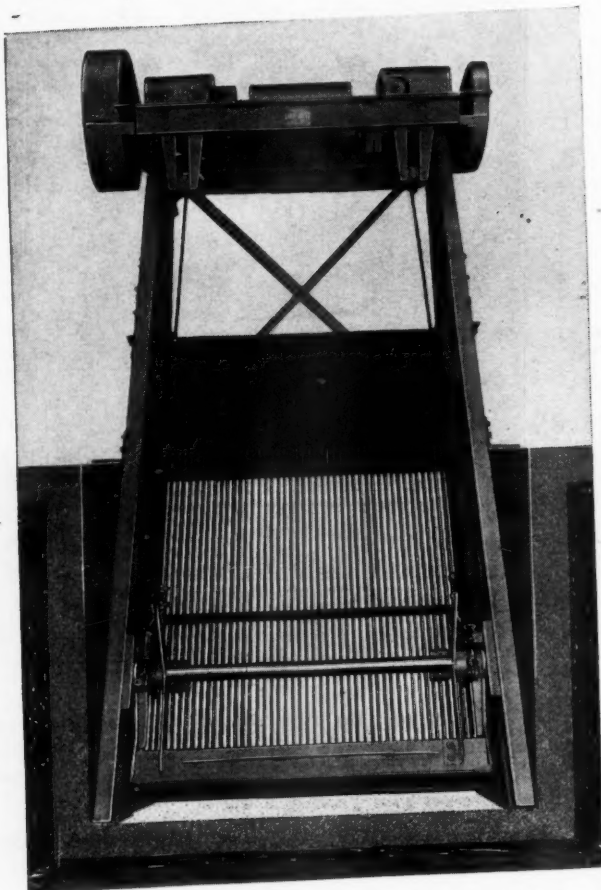
NEW YORK
40 Exchange Place
KANSAS CITY
1006 Grand Avenue
LOS ANGELES
417 S. Hill St.

DALLAS
1807 S. F. Bldg.
SALT LAKE CITY
149 W. 2d South St.
CHICAGO
2087 S. LaSalle St.

DENVER
226 Con'tl Oil Bldg.
SAN FRANCISCO
111 Sutter St.
PORTLAND, ORE.
611 Spalding Bldg.

STRAIGHTLINE BAR SCREEN

The Modern Screen for the Modern Plant



Showing rake at bottom ready to start cleaning screen bars.



Showing rake at top ready to return.

CONTINUOUS automatic removal of screenings from bar screens is a necessity in a modern sewage plant.

EVERY four minutes the accumulated screenings are brought up by the rake of the **STRAIGHTLINE** Screen and dumped into a trough or conveyor.

The rake is held free of the bars as it returns to the lower end of the screen to start another cycle of removal of refuse.

The control equipment used for the back and forth travel of the rake, is the same time-tried, dependable, simple and durable device that is used for the Link-Belt Skip Hoist; and can be varied for cycles of four minutes up to one hour, to suit conditions.

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For latest catalogs—consult the *classified INDUSTRIAL LITERATURE* section, beginning on page 5

reported to be employing the system. Current consumption was said to be 25 to 30 watts per cubic meter. This is equivalent to 2.32 to 2.78 watts per cubic foot of water.

As far back as 1909 or 1910, the City of Marseilles, France, proposed a competition in which the ultra-violet method took part and won. A unit ran for one month and sterilized water at a current consumption of 1 kw.-hr. per 1,330 cubic feet of water. This is, approximately, equivalent to 10,000 American gallons per kw.-hr. It is to be recollected that the figures as to Berea include current consumed by the rectifiers.

Canton Uses Liquid Sludge On City Farm

(Continued from page 28)

limited area was somewhat of a speculation in the early history of the plant, but experience has shown that for best results, the acreage should be refertilized about every four or five years. With this repetition, and the desire of abutting property owners for sludge for enriching their acreage, created by observing the results obtained on the municipal farm, we have what appears to be unlimited areas. In one instance, a farmer owning property adjacent to the city's farm purchased a small centrifugal pump, which he operated with a Ford tractor and sufficient pipe to transfer the sludge across a valley to his acreage. He is well pleased with his investment, the only disappointment being that the city cannot supply him with sufficient sludge. As a further indication as to how the agriculturists in the immediate vicinity of the plant feel regarding the use of sewage sludge in a wet form as a fertilizer, it may be stated that a number of farmers owning property some distance from the plant are now considering pooling their interest with a view of securing sufficient capital to purchase the necessary equipment for delivery of sludge to their acreage.

The scheme of sludge disposal as employed at Canton greatly facilitates the operation of the sewage treatment works. It is believed that most all sewage plant superintendents have experienced uncomfortable intervals, by not being able to move sludge from the settling tanks when desired. We all appreciate that sludge digestion does go wrong at periodical intervals, which causes serious difficulties in the proper operation of the sedimentation devices, and the one sure remedy for relief is removal of sludge from the tanks. Such sludge is always difficult to handle on drying beds because of the high organic content and inability to properly dry it. Such emergencies are easily met when the sludge is being disposed of in such a manner as employed at Canton. In the event the sludge is poorly digested and likely to give trouble from obnoxious odors, it is always possible to flow it over areas sufficiently far removed from habitation so as not to give rise to complaints.

In this connection, it should be mentioned that in many instances sludge has been distributed over quite large areas that were close to residential properties and public highways, and that no complaints from odors have come to the writer's attention. One probable explanation for the absence of odors is because the soil readily absorbs the contained water, thus leaving the sludge in a dry condition very quickly. On a number of occasions land has been

PITTSBURGH DES MOINES



Modern Filtration Plant completed in July, 1931, for the City of Findlay, Ohio. The Consulting Engineers were H. P. Jones and Company, Toledo, Ohio.

Two "Pittsburgh-Des Moines" Tanks Elevate the Water at Findlay's Filtration Plant

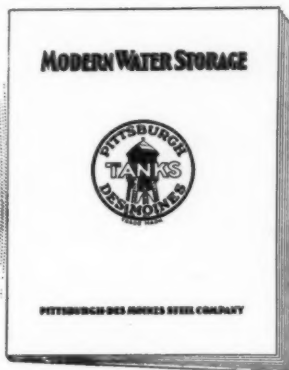
The smaller tank at the left holds 40,000 gallons and stands 48 feet to the top; the larger tank holds 500,000 gallons and stands 150 feet to the top.

These two "Pittsburgh-Des Moines" units assure the water mains of Findlay an ample supply at improved pressures—even during periods of peak demand. They also permit a simplified pumping schedule, and guarantee steady adequate service during interruptions in pumping for repairs or replacement work. The increased pressure guarantees plenty of water to outlying districts and to the newly built-up sections of the city.

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"Modern Water Storage," our new catalog, has just come from the press. It contains 28 pages of reliable information, interesting photographs, authentic engineering data, and "Pittsburgh-Des Moines" specifications on various types of elevated tanks, penstocks, pipe lines, standpipes, steel reservoirs, treating plants, and complete water systems.

Interested municipal and industrial executives may obtain a copy by addressing our nearest office.

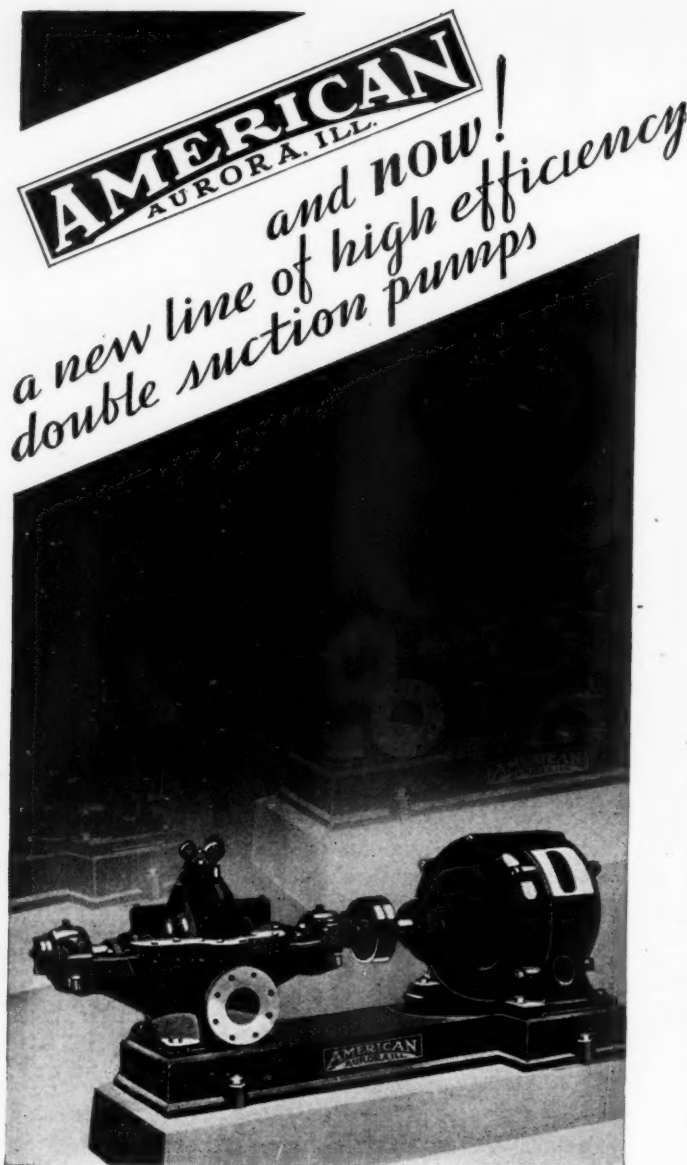
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The product of a company that has pioneered in the manufacture of pumping machinery—their performance is the result of the latest research and effort of experienced designers.

Engineering data is in the course of preparation and is available for comparison.

Low cost per gallon of pumping—simplification of design—and rugged construction is typical of the entire line!

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OMAHA, NEB.
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PORTLAND, OREGON
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SALT LAKE CITY, UTAH
SAN FRANCISCO, CALIF.

SEATTLE, WASH.
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TULSA, OKLA.
VANCOUVER, B. C., CANADA

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rather heavily sludged one day and cultivated the following day.

Another feature of the scheme that appeals to the writer is that sludge of low water content—a conditioning problem that is difficult and one that is desired where the sludge is to be handled on drying beds,—is of little or no advantage where the sludge has to be pumped. As a matter of fact, a sludge that contains more than 6% solids is difficult to handle through a force line because of the excessive friction loss. This phase of the problem at Canton requires some watching, because of the long force line and the excessive elevation to which the sludge is raised. There have been times when it was necessary to thin some of the heavier sludges either with water or a more liquid sludge.

The classification of costs of operating the Canton Sewage Works does not permit of detailed accurate analysis to illustrate the merits of the scheme from an economical viewpoint. Rough estimates, however, indicate that the cost of placing of the wet sludge on the farming acreage is no greater, and perhaps less, than the cost of removing the sludge from drying beds. Other items of expenditure, such as costs of constructing sludge drying beds and necessary appurtenances, and maintenance, depreciation and interest on investment, are believed to be much in favor of the scheme as employed at Canton. Sufficient net revenue is derived from the sale of farm products to more than pay the interest on the purchase price of the land.

Another item that is significant, and one that is hard to value, is the increased value of the property due to the general building up of the soil. No doubt sewage sludges vary greatly in their fertilizing value and will react differently when applied to the many different soils and crops, but the writer's experience, not only in Canton but elsewhere, has strongly indicated general strengthening of the soil.

It is not the desire of the writer to place another burden on the shoulders of the sewage plant operator by suggesting that he become a farmer, as it is believed that he now has ample duties, but it would be unfair to say that the operation of the municipal farm has been anything other than a pleasure. Perhaps one thing that makes it a pleasure is the fact that an otherwise useless product is being turned back to nature and again placed in useful channels.

The above was read by Mr. Hommon before the North Carolina Water and Sewage Works Association. In discussion of it, the facts were brought out that High Point, N. C., is using sludge on a 280-acre prison farm; and that Charlotte disposes of part of its sludge on city-owned land around the treatment plant, which it cultivates, but finds the odors therefrom very much of a nuisance.

What Equipment Is Covered by the Contractor's Bond?

(Continued from page 26)

folding to support the men at work on a bridge and the materials of the superstructure while under construction were held covered by a bond under the Alabama statute. Union Indemnity Co. vs. State, 217 Ala. 35, 114 So. 415.

Lumber used in the building of camps and store-rooms was held within a highway contractor's bond given under the New Mexico statute. American Surety Co. vs. James A. Dick Co., C. C. A., 23 Fed. (2d) 464.

Under the Florida statute, which was copied from the federal statute, the materials supplied must not only substantially conform to the specifications required for such materials, but under the special circumstances of the case such materials must form an integral part of the work and be necessarily involved in it.

If the contractor purchases materials and afterwards diverts them to other and different uses, the material man by such bad faith of the purchaser, must stand the loss, because it is he who is thereby defrauded, and the government has derived no benefit from the use of the materials.

Lumber supplied the contractor in connection with the municipal docks of a city was alleged not to have been used in the prosecution of the work. The burden was held on the material man to prove the use of the lumber in the work as above stated. *Kidd vs. City of Jacksonville*, 97 Fla. 297, 120 So. 556.

A bond covering construction work in a particular district covered only materials used in the work in that district, and not materials furnished the contractor and used elsewhere. *Union Indemnity Co. vs. Benton County Lumber Co. (Ark.)*, 18 S. W. (2d) 327.

Stone for Construction

The Missouri courts, where the bond does not conform to the statute, will treat it as a common-law bond and give it such construction as its terms authorize regardless of the statute. A bond given by the contractor for the erection of a hospital for a city was given to secure the payment of materials furnished for use in the building by persons "who have contracts directly with the principal for * * * material." This was held to be a common-law bond and not a statutory bond, and, under its terms, did not cover stone purchased by and furnished to the subcontractor to furnish the stone to be used in the erection of the building. *City of St. Joseph vs. Pfeiffer Store Co. (Mo. App.)* 26 S. W. (2d) 1018.

A Composite Highway Bridge in New Mexico

(Continued from page 19)

on and greased and the driver moved ahead for the next bent.

In a few channels, where the water ran swift and deep, it was difficult to set the piles accurately; but by placing a line of heavy stock fencing across these upstream, the water was retarded, a bar formed and the flow directed to other channels.

Drilling of bolt holes through the sway braces and piles was done by air drills run from an air line laid along the bridge. Where there was a space between a sway brace and either cap or pile, it was filled with a creosoted shim.

The I-beams were received unpainted and the contractor put on a red lead shop coat with a Binks spray gun outfit. A hole was punched in the flange at one end of each stringer to receive a $\frac{3}{4}$ in. lag screw, which also passed through the bed plate and into the cap as an anchor, another lag screw also being used for the bed plate. The other end of the stringer was left free to move on its bed plate with temperature changes. By means of an acetylene torch, holes were burned in each end of the beam through which to pass the reinforcing bars for the concrete tie beams.

The steel was unloaded close to abutment No. 1, lifted by a stiff-leg derrick onto a car running on the



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A Wood hoist and body installation is pictured, spreading top dressing. A ball check pump holds the body at any desired angle, while the truck is in motion. The tailgate spreading device allows even material distribution. Smooth floor permits clean discharge. And all-steel construction gives long life. *All Wood equipment sold under life time guarantee. Write for literature.*

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1. Telescope can be adjusted like a Wye level.
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8. Sharp focus at 4 feet.
9. Cylindrical telescope axle.
10. Non-cramping leveling head.
11. Dual-bearing in standards.
12. Sturdy construction.

No other instrument offers all these advantages.

Furnished with or without compass and with or without arc.



Warren-Knight Transit-Level Model 38-b.

Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa.
Send me 64 page illustrated catalogue PW511 of Warren-Knight Transits and Levels showing inside views of re-inforced construction.

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two downstream stringers, on which it was pushed out by hand, to be picked up by another stiff-leg and placed in position. It was painted two field coats with the spray gun, except on windy days when the hand method was used. White lead in oil with lamp black to give a battleship gray color was used.

As soon as the steel setting was far enough along to insure that the form carpenters would not be held up, form work was started, and enough provided to pour 18 half spans of roadway and 27 sidewalk spans; the other half of the roadway being left for carrying out the steel.

Concrete was made at a central mixing plant about three miles away and hauled by trucks to a hopper, reached by an incline, near Abutment No. 1. From the hopper it was dumped into buggies, wheeled out by hand and dumped into the forms. A man was kept at the hopper to spade the concrete and correct any segregation that occurred during hauling. After 27 spans had been formed the hopper was moved out to span 27 and the concrete trucks backed out to it over the completed floor.

Due to the concrete tie beam made monolithic with each slab at each end of it and also to the copper expansion plate at each joint, alternate spans were poured, and the intermediate spans two days later; the day between being used for changing header boards, placing reinforcing steel and getting ready for the next pour.

As soon as possible after pouring the concrete, it was covered with burlap and wet down, and the next day covered with sand, which was kept wet by sprinkling. The roadway and sidewalk slabs were mixed 1:2.2:3.2. Test cylinders, made for every 100 cu. yd. poured, tested well above 3,000 lb. per sq. in. The handrails were precast, the posts poured in place, using a one-bag mixer set up on the bridge.

The bridge and approaches were completed in 156½ working days—180 days were allowed by the contract.

The contract was let to Armstrong & Armstrong, of Roswell, N. M., and sub-let to the Levy Construction Co. of Denver for whom J. H. Miner was directly in charge, with Chas. O'Leary as superintendent.

Water Services and Location of Mains

(Continued from page 32)

services placed in advance of paving, the new house or building can be given the size and location desired.

When it is proposed to pave a street, it is often found that there is a small main existing of sufficient size for the demand at that time. It is hard to justify the laying of a main large enough to meet the probable future requirements of that district and territory beyond it. In such cases it is entirely practical and wise economy to lay pipe under each street intersection in advance of the paving with the pipe ends extending slightly beyond the curbs into the parking strips of the size and location required by a plan worked out for the probable future requirements. Then, when the territory justifies the expenditure, the larger pipe can be laid between intersections and the services cut over to the new main.

In addition to the objections mentioned in your article against laying services in advance of paving, such as the added investment and difficulty in finding leaks under paving, there is the fact that most of these blind services will never be used. A great many when wanted will be found too small or clogged with rust. Many will be so located that concrete driveways or walks will be over them or not where desired by the owner or plumber. Results so far from services laid in advance of paving seem to indicate that it will be very doubtful if 50 per cent will ever be used.

R. H. COREY,
Salem, Oregon.

Snow Removal Methods and Equipment



Improved Western Snow Plows for Mounting on Trucks

Of the various modern types of snow plows available today, there is no piece of equipment that serves so well—from perhaps every practical standpoint—as that which can be readily attached to, or detached from, the front end of the motor truck.

If it is designed so that the driver can make the hook-up without any difficulty and so that he can take it off even more easily, there is always available a ready piece of snow fighting equipment which, when the work of snow removal is completed, can be set aside while the truck is used for other purposes.

A substantial snow plow mounted on a truck forms a comparatively high speed combination that is capable of covering considerable mileage in a relatively short length of time. Unquestionably the greatest speed possible in handling snow, either as it falls or immediately thereafter, gets the best results. The snow is lighter, is not packed down hard, and is therefore capable of being moved much more easily and at a more rapid rate. If the speed and power of a truck are placed behind a

rugged plow, a considerable amount of snow can be cleared rapidly, permitting long stretches of thoroughfare to be opened almost immediately.

Western Snow Plows can be attached to standard motor trucks of small, medium or large sizes—special models

straight blade and "V" shape plows fit the same frame and may be used interchangeably, as needed; thus owners who do not have a constant use for both types, but who are likely to need first one and then the other, are relieved of the expense of purchasing a large number of plows complete with frames.

This variety of equipment provides a wide choice to take care of every possible condition that is ordinarily encountered in snow removal work. Bulletin W-31-

Straight Blade (Moldboard Type) Plows

Height	Length	Swath	Wt. of Truck Recommended
*21"	10 feet	About 8 feet	Not less than 2 tons
*30"	10 feet	About 8 feet	Not less than 2½ tons

*Can be equipped with extension to raise height of blade.

Tapering Blade (Moldboard Type) Plows

18" to 30"	7 feet	5'—9"	Ford AA and Chevrolet 6 cyl.
------------	--------	-------	------------------------------

"V" Shaped Plows

34" front } 46" rear }	(Less wings) 8'—9"	Not less than 3 tons
34" front } 46" rear }	(With wings) 15'—10"	Not less than 3½ tons

have been designed for use in Ford (Model AA) and Chevrolet 6-cylinder units. The table following shows the broad line and the various sizes that are available to suit the needs of either the small or large community. The 10-foot

K, which has just been prepared, giving detailed descriptions and illustrations, can be obtained by writing The Austin-Western Road Machinery Co., Chicago, Illinois.

In addition to the above equipment, this company is in a position to supply very effective snow blades and plows for use with either Austin Single or Dual Drive Motor Graders. When so equipped, Austin Motor Graders become year-around machines; serving as maintenance units when roads are open or as snow plows during the winter.

LaPlant - Choate Hydraulically Operated Plow

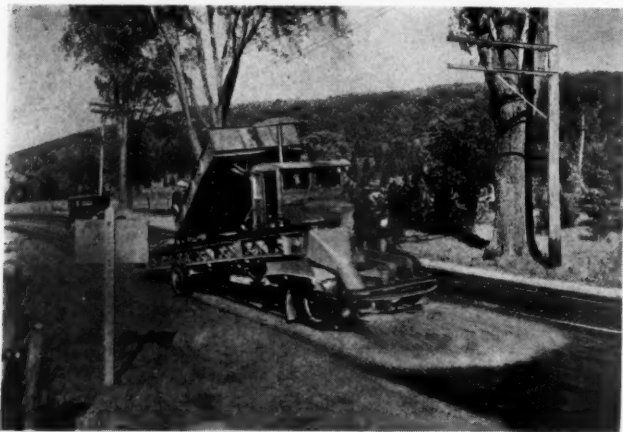
The LaPlant-Choate Mfg. Co., Inc., has brought out a new and improved hydraulically operated snow plow for use with the Sixty tractor. The control levers are placed within the cab so that the plow or wings can be very easily and conveniently raised or lowered. The plow is mounted on a center pivot which assures maximum traction and easy control.



Western "V" type Snow Plow with wings in extreme raised working position

Reliance Sand and Gravel Spreader

The Universal Road Machinery Co., Kingston, N. Y., has brought out a new spreader that operates well under all conditions, spreading fine or coarse sand, or sand and gravel dry, or as it comes from the bank. It is suited for spreading on oil or ice, or for building



Reliance Sand and Gravel Spreader

sand and gravel roads. It spreads a heavy cover 8 to 12 feet, or will sand any width up to 30 feet. The amount of material applied per square yard, the width and depth of spread and the direction of travel are all under the operator's control from a seat so located that he can observe closely the work being done. The equipment places cover ahead, so travel is always on a covered surface.

The spreader will handle up to 60 tons an hour and effects a large saving in material. When spreading heavy cover, it operates at 5 to 6 miles an hour; when sanding, at 10 to 15 miles.

A demonstration will be arranged on request to the manufacturers.

3 Cu. Yds. Per Min. Capacity of New Haiss Loader

The George Haiss Manufacturing Company of New York has now introduced their new Haiss Model 80



The new Haiss Loader Model 80 is particularly adapted to snow handling.

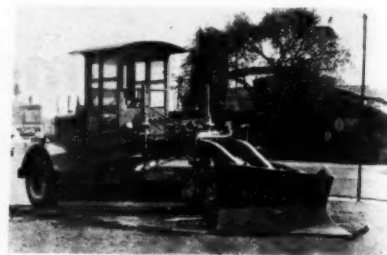
Loader, said to be the heaviest, most powerful and strongest loader ever built. It has demonstrated an average capacity in excess of 3 cu. yds. per minute, even under difficult conditions. A large New York City operator of sand and gravel yards, reports a loading time of 3½ minutes, putting up 15 consecutive runs of 12 cu. yd. loads of crushed stone.

The bucket elevator is interchangeable with a flight-conveyor snow boom for winter snow loading. The weight of the machine is 16,500 lbs. Despite its great size and capacity, the Model 80 is exceptionally easy to operate. There are only six controls in all. Each motion requires only one hand-movement. A skilled operator is not required; in fact, a few hours' experience is said to assure fullest efficiency.

Write the George Haiss Manufacturing Company, Inc., at 141st Street and Park Avenue, New York, and they will send you complete information.

Caterpillar Auto Patrol Snow Plow

Caterpillar Tractor Co., Peoria, Ill., announces a new unit designed to operate as efficient road maintenance equipment, and also on snow removal. Posi-



Caterpillar Auto Patrol Snow Plow

tive traction is obtained from both wheels; there is no differential, so that one wheel will not slip in snow or ice. A scarifier is attached.

Motor Truck Developments

New General Motors 1½ to 2 Ton Truck

Enlargement of the General Motors truck line to include a 1½ to 2-ton truck, powered with a six-cylinder 60 horsepower GMT-200 engine, on both a 131-inch and 157-inch wheelbase and priced at from \$595 to \$665, has just been announced by the General Motors Truck Company at Pontiac, Mich. The new truck, known as the Model T-18, is said to be the lowest priced truck of its rated capacity in the industry and is the lowest priced truck ever presented by this company.

Both 9-foot and 12-foot bodies of any type desired are possible on this new truck through use of the two wheelbases.

A feature of this truck is found in the flat tube and fin type radiator, which offers positive protection against freezing. In this type of radiator, the tubes expand into cylindrical shape if frozen preventing breaking.

With a turning radius of 22 feet, 9 inches, for the 131-inch wheelbase and 28 feet, 3 inches for the 157-inch wheelbase, the new truck is easily handled in traffic and in close quarters.

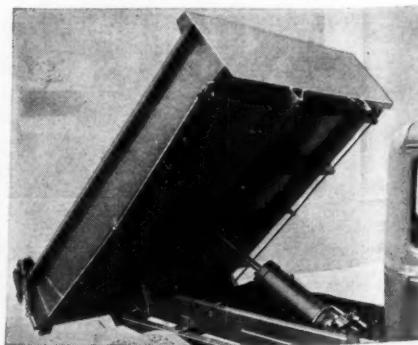
Massachusetts Highway Department Truck Specifications

The Massachusetts State Highway Department has recently ordered four more FWD trucks, making a total of 111 in the service of that state. It is of interest to note the equipment specified for these trucks, which will be called on to do most intensive highway

work. They are powered with an 85 h.p. engine, through a 7-speed dual range transmission. Two separate and independent 4-wheel brakes are included, with balloon tires, 9.00-20, singles front and duals rear, which are mounted on cast steel spoke wheels. The cabs are of coupe type, mounted to prevent sag and overcome distortion. The wheelbase is 138 inches, which provides for mounting a 2-yard end-dump body operated by an hydraulic hoist.

New Wood Heavy Duty Hoist

A new power-operated hydraulic hoist for heavy duty service on 1½ ton chasses has been recently put on the market by the Wood Hydraulic Hoist and Body Company, Detroit. The new hoist is known as Model D6. No wood sills are required when installing it, as the hoist and body come ready-mounted in a pressed steel subframe needing only to be bolted to the chassis.



Wood Heavy Duty Hoist for 1½-ton chassis.

DAYTON-DOWD CENTRIFUGAL PUMPS

FOR

Waterworks and Filtration Plants
Sewage Disposal Plants
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Designed and built by Centrifugal pump specialists of long experience

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No caulking
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A saving in cost of material and labor
Deep bell holes unnecessary

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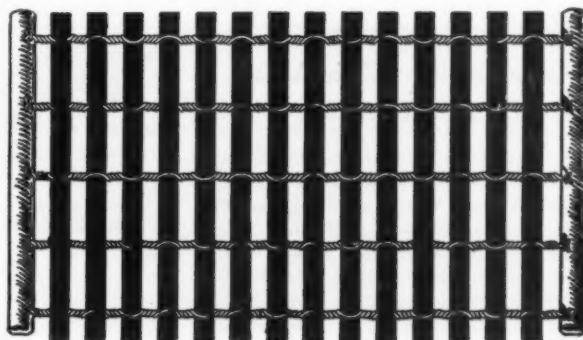
DAILY RATES:

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from **\$2.50** for two

Write for literature and
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Mattson Snow Fence



Meets the various state highway specifications—made from heavy pickets which are cut especially for our use, woven between the best grade of copper bearing steel wire, heavily galvanized to give maximum protection from rust.

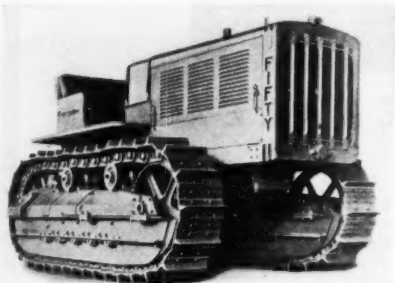
Shipment can be made from branches located conveniently in your territory.

Mattson Wire & Mfg. Co., Inc.

Main Office, Joliet, Ill.

The "Caterpillar" Fifty

Another member of the "Caterpillar" Tractor family—"Caterpillar" Fifty Tractor—takes its place in the "Caterpillar" line. Between the Thirty and the Sixty in size, it fills an important gap in the power range. It develops fifty maximum drawbar



The Caterpillar "Fifty"

horsepower—the Sixty develops sixty maximum drawbar horsepower, and the Thirty develops thirty maximum drawbar horsepower. Its shipping weight is approximately 16,500 pounds. Its list price is \$3,675.00 f. o. b. Peoria.

In general appearance the Fifty follows the lines of design of the three smallest sizes in the "Caterpillar" Tractor line—hood enclosure for the engine, fuel tank just behind the engine, a wide, cushioned seat for the driver, all controls conveniently placed and within easy reach.

Galion Roller With Allis-Chalmers Engine

The new Galion Master, 4-cylinder motor roller, recently brought out by the Galion Iron Works and Mfg. Co., Galion, O., is powered with the Allis-Chalmers Model K engine, which is the motor used in the Allis-Chalmers E. wheel-type tractor, and the "35" crawler type tractor. The new Galion roller is shown herewith.



Galion Roller with Allis-Chalmers Engine

with Acitite. Its service is immediate. It hardens within a few minutes of application. Its use is simple in the extreme, requiring no other ingredients. It is a completely homogeneous compound of low specific gravity (about 2), shipped in granulated or solid form, and melts over moderate fire at 250° Fa.

For Efficient Construction

Acitite—An Acid Proof Compound

The Sullivan Co., Memphis, Tenn., manufactures Acitite, which is a product designed for the protection of all surfaces subjected to the corrosive effects of acids and chemicals. Metal, masonry, cement, steel, wood and stone—any rough surface—can be treated successfully with this chemical-resisting product.

It is a positive non-electrical conductor, waterproof, oil-proof, and impervious to atmospheric conditions. Surfaces treated with Acitite are practically immune to concentrated or diluted hot or cold, Sulphuric, Hydrochloric, Nitric, Acetic and Lactic Acids and Chlorine Gas.

It has the advantage of being quick-setting, the delay characteristic of other similar treatments being eliminated

It keeps indefinitely—can be stored anywhere without the slightest deterioration in substance or quality and used over and over again without losing its properties.

An Innovation in Modern Tractor Equipment

The Hercules Crawl Tractor, the newest development in crawler tractors just announced by The Hercules Company, Marion, Ohio, brings the field of usefulness of the tractor and road roller into the capacity of one machine—a definite contribution to hasten the return of prosperous times.

This new machine was developed to meet the requirements of heavy duty tractor uses and to fill the need of heavy construction for road contractors, Municipal, Township, County and State Highway departments, for a machine that would reduce the capital investment required for two separate pieces of equipment and supply one unit with the full utility of two.

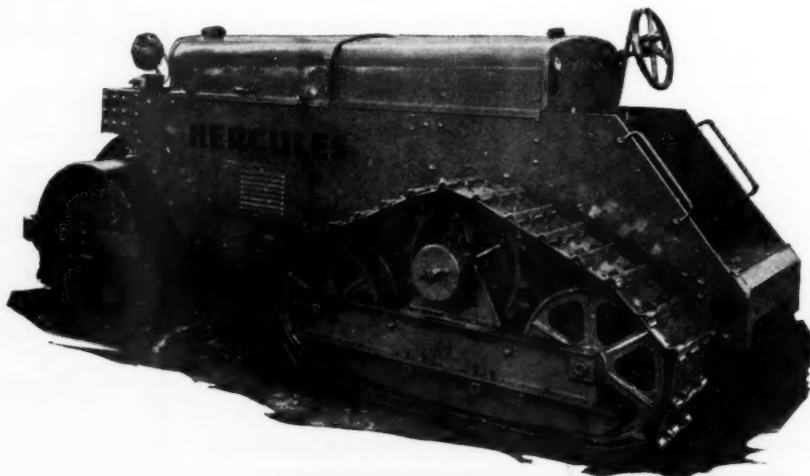
The Hercules crawl tractor is a standard Model 60, 80 or 100 Hercules chassis mounted on two rugged crawler tracks. These crawler tracks fit all Model 60, 80 and 100 Hercules road rollers including those now in service. All that is necessary to convert the Hercules crawl tractor into a Hercules roller is to jack up the rear end, take off the crawler trucks, and replace the roller wheels. The Hercules scarifier can be used with either equipment.

The Model 60 crawl tractor develops a draw bar pull of 8,000 to 10,000 pounds which may be increased for special work. The draw bar pull of the Models 80 and 100 is greater in proportion.

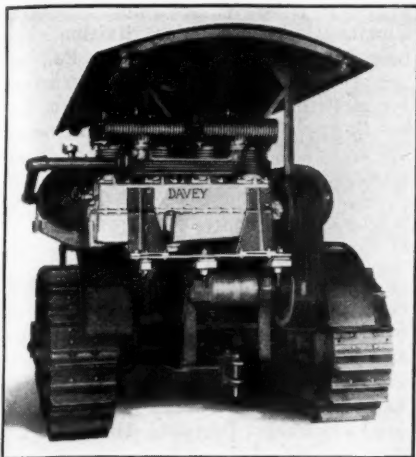
All models have three speeds forward and backward—direction and motion being controlled by the movement of a single operating lever. The standard Hercules tractor has a speed of ½ M.P.H. in low, 1½ M.P.H. in second, and 2½ M.P.H. in high, and these speeds can be increased or decreased to meet special operating conditions. As a roller the standard Hercules machine develops 1½, 3½ and 5½ M.P.H. in low, second and high gear respectively.

Trail-It Wagons for Low Cost Dirt Moving

The Trail-It Co., 2518 Wabash Ave., St. Paul, Minn., manufacture the Trail-It wagon, which is especially adapted for moving dirt with an elevating grader. This wagon is attached directly to a tractor, which supports the front end of the wagon. Loads are dumped without stopping, and control is very easy for both loading and placing the load. Capacity is 91 cubic feet; turning radius is less than 15 feet; wheels are 12 inches wide.



Hercules Crawl Tractor



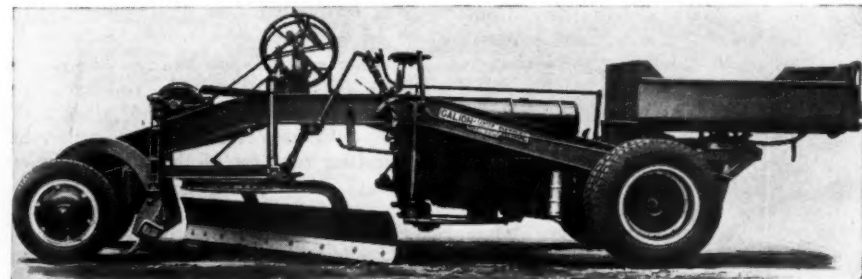
Davey Caterpillar Mounted Compressor

Davey Air-Cooled Compressor Unit

Davey Compressor Co., Inc., Kent, O., have just brought out a 310-foot air-cooled portable compressor for mounting on the Caterpillar Sixty tractor. Mounting of this compressor does not interfere with normal tractor draw-bar operation; and the light weight—only 1800 pounds—does not interfere with tractor balance or use. Compressor drive is by the tractor engine through five V-belts.

"Anti-Hydro"

The Anti-Hydro Waterproofing Co., 265 Badger Ave., Newark, N. J., states that their compound, Anti-hydro, when mixed with any standard brand of portland cement has the following advantages:



The Galion Grader with dump body

It attains high early strength, so that patched concrete pavements may be opened to traffic in 24 hours after placing the concrete; it makes new concrete bond securely to old; it costs about half as much as other quick-setting ce-

New Equipment

ments; it does not clog the mixer; shipped in steel drums; is not affected by weather or rain; requires no extra shed; and hardens and waterproofs the concrete.

Wehr Grader With Case Tractor

Herewith is shown a Wehr center controlled grader, powered by a Case, model CI tractor, which is owned by Schwerm Bros., contractors, of Milwaukee, Wisc. The machine is being

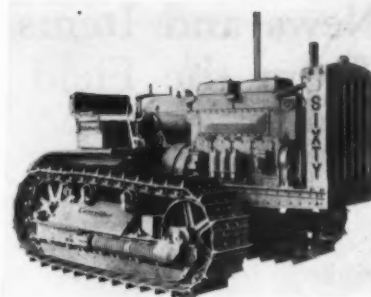


Center Control Wehr Grader with Case C. I. Tractor

used to clear the grass and weeds from, and smooth down, a space for a sand and gravel storage pile in a highway contract near Allenton, Wisc.

The "Caterpillar" Diesel Tractor

Caterpillar Tractor Co., Peoria, Ill., has announced a Diesel Sixty tractor.



The Caterpillar Diesel

The "Caterpillar" Diesel engine is started by a small two-cylinder "Caterpillar" engine, compactly mounted on the left side of the main power unit. The starting engine is cranked by an easily accessible crank—it operates on gasoline or other high-volatility fuel and connection to the main power plant is automatically disengaged when operating speed is reached.

The "Caterpillar" Diesel engine uses any oil commonly merchandised as Diesel Oil, normally sold in the United States at prices one-third to one-half the price of standard automotive gasoline. Fuel consumption, moreover, is thirty to forty per cent lower than that of an equivalent-powered gasoline-burning engine.

The "Caterpillar" Diesel Sixty Tractor is the only Diesel-powered model in the "Caterpillar" line—it is an addition to the line and does not displace the standard gasoline driven Sixty.

A characteristic of Diesel design is the elimination of carburetor and magneto.

For the present, the production of these tractors is very limited. All orders are subject to the acceptance of the Research Division so that their several years of development and field tests may be supplemented by close observation of these tractors in field use.

Galion Grader With Dump Body

Galion Iron Works & Mfg. Co., Galion, O., makers of the Galion center control graders, manufacture a dump body attachment, as shown herewith, which enables the grader to work both as truck and grader, carrying and distributing patch material, thus making it a maintainer in every sense of the word. It is equipped with a power operated gravity dump which makes it easy to unload and spread loose materials.



This 8-inch concrete road was hardened and waterproofed with Anti-Hydro.



These 25 Dodge Brothers trucks were purchased by the Kentucky Highway Commission. They are 1 1/2-ton units with Wood hydraulic hoists and bodies.

News and Items From the Field

G. M. Walker has been appointed advertising manager of the Caterpillar Tractor Co. Walter H. Gardner, formerly advertising manager, becomes manager of the Specialty Sales Division, a newly formed division, created primarily to market "Caterpillar" en-



W. H. Gardner

gines and sub-assemblies to other manufacturers. The full line of "Caterpillar" engines, both gas and Diesel, will eventually be adapted for the use of equipment manufacturers generally.

This division will also direct the company's present activities in promoting sales to railroads and public utilities.

The Standard Oil Co. of Indiana has announced the biggest advertising campaign the company has ever undertaken in a short period. The directors of the company have decided that the way to end the trench warfare with depression is to carry on something in a business way that is what a major offensive is in warfare. For the most part, this campaign will stress a new type of gasoline, but it will also cover motor oils. It will include newspaper, trade and class journal, radio and direct mail advertising, and will continue until mid-December.

The International-Stacey Corp., Columbus, O., announces the purchase of all the stock of the Stacey Manufacturing Co., Cincinnati, O., which concern will now be known as the Stacey Gas Construction Division of the International-Stacey Corp. The line of equipment put out by this corporation is very large, including blowers, meters, gas pumps, centrifugal pumps, liquid pumps, vacuum pumps, standard steel buildings, tanks, penstocks, and oil, gas and artesian well products.

Dean C. Babcock, branch sales manager of the Four Wheel Drive Auto

Company, died at Wausau, Wisc., September 1. He was born at Kaukauna, Wisconsin, October 30, 1896. He attended Carroll College at Waukesha, Wisc. After graduating from Carroll, he entered the employ of the Nekoosa-Edwards Paper Company as a member of their chemical staff, where he remained for three years. In March, 1920, he joined the F. W. D. organization as a member of the sales department. In January, 1926, he became branch manager in charge of all factory branches.

A contract for corrugated galvanized metal culverts amounting to more than \$500,000 was recently awarded to the Canton Culvert Company, Canton, O., by the Division of Highways of the State of Pennsylvania. This order is said to represent the largest single contract ever placed for culverts of this type. It calls for approximately 700,000 lineal feet of culverts, totaling 130 miles end to end, in diameters from 12 to 48 inches.

Important additions have been made recently to the staff of the Worthington Pump and Machinery Corporation, 2 Park Avenue, New York, N. Y. At the same time, certain organization changes also were announced. Otto Nonnenbruch, for the past four years chief engineer of the Diesel department of I. P. Morris and De La Vergne, Inc., Philadelphia, Pa., and prior to that with Worthington in various capacities for nine years, rejoined the latter organization as of July 1. Mr. Nonnenbruch will make his headquarters at Buffalo, N. Y. as special sales representative. J. B. Allen, formerly president of the Allen Engineering Company, Bridgeport, Conn., and prior to that time with the Sperry Gyroscope Company, Brooklyn, N. Y., has been appointed special marine representative with headquarters at Harrison, N. J. H. G. Wood, formerly assistant manager of the New England division of the Westinghouse Engineering and Manufacturing Company, has joined the Worthington organization in the capacity of electrical sales engineer. E. M. Paullin, Jr., has been appointed electrical sales engineer at the Cincinnati, Ohio, Works of the Worthington Corporation. Mr. Paullin was associated with the New York office of the General Electric Company as synchronous motor specialist. John T. Clancy, assistant manager, Buffalo Works sales division, has transferred his headquarters from Buffalo to Harrison, N. J. E. W. Hammond, formerly located at Buffalo, has been transferred to Los Angeles as special representative of Diesel and gas engine sales on the Pacific Coast. A. M. Boehm goes to Kansas City as Diesel and gas engine specialist. He formerly was in the Sales department at Buffalo Works. Joseph F. Hecking, formerly with the Diesel engine sales division in New York, has been assigned to the Diesel and gas engine sales division at Buffalo.

William J. Daly, assistant manager, Cincinnati Works sales division, has been assigned to Pittsburgh, Pa., on special sales work. G. A. Herrmann, formerly sales engineer at Chicago, has been appointed acting district manager at St. Paul. W. R. Kennedy, sales engineer at Pittsburgh, has been appointed acting district manager at Kansas City.

Protective Coatings.—This booklet describes the various coatings that can be applied to Armco spiral welded pipe, and gives the advantages of each. These are: Mill coating, asphalt enamel, galvanized, leadized, rubber lined and porcelain enamel. Probable life and other data are included.

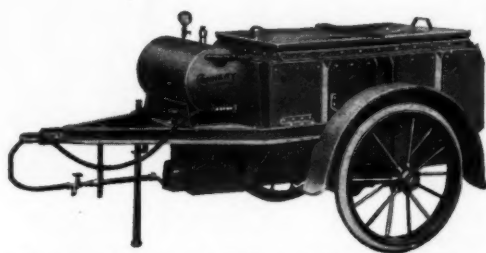
"Keeping Trucks in Condition for Keeping the Highways Open" is the title of a thirty-two page booklet just issued by the Four Wheel Drive Auto Company. Copies of the book are available for all who are interested in snow removal. The first section of the book is devoted to snow removal methods and equipment, while the last section is on the care of snow removal equipment. The book is beautifully printed in two colors and is well illustrated. We will be glad to send you a copy. Just send us your request.

Downes Covers and Sludge Equipment.—The Pacific Flush Tank Co., 136 Liberty St., New York, have just brought out a 48-page illustrated catalog on Downes Floating Covers and Sludge Digestion Equipment. This is very complete and includes interesting photographs of cover installations and much technical and design data. Copies will be mailed free on request.

Austin Badger Tractor Shovel.—The Austin Mfg. Co., Chicago, Ill., have issued bulletin 1236, illustrated, 16 pages, describing in detail the outstanding features of the Austin Badger shovel. This equipment is sold in the United States by the Austin-Western Road Machinery Co., Chicago.

Colas Roads.—Durable, low-cost roads are covered in a booklet of 34 pages, fully illustrated, which has been published by Colas Roads, Inc., New York City. Among the points covered are penetration method, surface treatment, gravel roads, maintenance methods, premixed macadam, resurfacing brick, concrete and other hard surface roads, airport surfacing and sidewalks. A valuable reference book.

"Modern Water Storage" is the title of a new booklet just issued by the Pittsburgh-Des Moines Steel Co. It contains 28 pages of reliable information, interesting photographs, authentic engineering data and "Pittsburgh-Des Moines" specifications on various types of elevated tanks, penstocks, pipe lines, stand pipes, steel reservoirs, treating plants and complete water systems. Copies free on request.



We manufacture a full line of Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches, Hand Spraying Attachments, etc. Send for our "Blue Book" illustrating our complete line.

CONNERY'S

Style "J" Oil Burning Kettle will guard any highway with economy and efficiency. Something easy to handle and quick to heat. Equipped with standard roller bearings, springs, improved oil burner and rubber tired wheels and heat guards if desired. In Connery's Tar and Asphalt Heaters, contractors, town and city officials will find the very highest development of superior workmanship and design. Kettles are made in twenty styles and sizes, in capacities of 10 to 1000 gallons.

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Write us regarding your water problem. Estimates are given cheerfully and entail no obligation.

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PROVIDENCE, R. I.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, OF PUBLIC WORKS, published monthly at New York, N. Y., for Oct. 1, 1931.

State of New York } ss.
County of New York }

Before me, a notary public in and for the State and county aforesaid, personally appeared J. T. Morris, who having been duly sworn according to law, deposes and says that he is the Business Manager of the PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Public Works Journal Corp., 310 East 45th St., New York, N. Y.; Editor, A. Prescott Folwell, 310 East 45th St., New York, N. Y.; Managing Editor, none; Business Manager, J. T. Morris, 310 East 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern its name and address, as well as those of each individual member, must be given.) Public Works Journal Corp., J. T. Morris, W. A. Hardenbergh, A. Prescott Folwell, S. N. Hume, Croxton Morris, all of 310 East 45th St., New York, N. Y.; F. Clay Viguerie, 42-66 Phlox Pl., Flushing, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none so state.) Swetland Publishing Co., 239 W. 39th St., New York, N. Y. (Stockholders unknown).

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only.)

J. T. MORRIS,
(Signature of business manager.)

Sworn to and subscribed before me this 14th day of Oct., 1931.

(Seal)

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ENGINEERING SOCIETIES

Asphalt Institute Expands

With a substantial increase in its membership, seven more large oil companies having recently joined its ranks, The Asphalt Institute, New York, trade organization of the asphalt producers, will soon extend its activities to the Pacific Coast with a branch office in San Francisco.

The seven new companies which have joined the Asphalt Institute are the Standard Oil Company of California, the Union Oil Company of California, the Shell Oil Company of California, the Associated Oil Company of San Francisco, the Gilmore Oil Company of Los Angeles, the Colonial Beacon Oil Company of Boston and the Indian Refining Company of Lawrenceville, Ill. Companies already members of the institute are the Standard Oil Company of New Jersey and the Standard Oil Company of New York, both with general offices in New York City; the Texas Company and the Hastings Pavement Company, also of New York; the Barber Asphalt Company, Philadelphia; the Standard Oil Company of Ohio, located in Cleveland; the Standard Oil Company of Louisiana, with general offices in New Orleans; the James B. Berry's Sons Company of Chicago, and the Shell Petroleum Corporation of St. Louis. The probabilities are that several more companies will join the institute during the next few months.

Officers of The Asphalt Institute recently elected for the fiscal year 1931-1932 are as follows: President, W. H. Kershaw, The Texas Company, New York City; Vice Presidents, C. W. Bayliss, Barber Asphalt Company, Philadelphia, and B. L. Boye, Standard Oil Company of New York, New York City; Chairman, Executive Committee, J. S. Helm, Standard Oil Company of New Jersey, New York City; Secretary, A. M. Maxwell, Standard Oil Company of Ohio, Cleveland; Treasurer, Herbert Spencer, Standard Oil Company of New Jersey, New York City, and Managing Director, J. E. Pennybacker, New York.

The Board of Directors, as now constituted, is as follows: W. H. Kershaw, J. J. Gartland, J. S. Helm, Herbert Spencer, Henry Fisher, B. L. Boye, E. J. Morrison and P. L. Thompson, all of New York; A. M. Maxwell and A. A. Stambaugh of Cleveland; C. E. Miller, H. B. Fuller and M. A. Giff, Chicago; L. van Eeghen and Leroy M. Law, St. Louis; J. E. Morris and C. W. Bayliss, Philadelphia; A. Clarke Bedford and E. Beach Smith, Boston; R. W. Williams, New Orleans; W. G. Julier, Howard M. Loy, Lawrence Wolff and Francis P. Smith, Jr., Los Angeles; John Floyd McSwain, Raymond Harsch, J. A. Blood, W. M. Morse, E. Whitehead, and Karl E. Kneiss of San Francisco, and P. C. Scullin and J. S. Worden, Lawrenceville, Ill.

Iowa Sewage Treatment

The 1931 Iowa Sewage Treatment Conference will be held at Iowa State College, Ames, Ia., November 18-20. The conference will be open to those interested in and responsible for municipal and industrial waste disposal.

Convention of the American Society of Municipal Engineers

The convention on October 19th to 23rd of the American Society of Municipal Engineers was the first since it adopted that name, but the thirty-seventh since it was organized as the American Society of Municipal Improvements. This convention was well attended—more than 400 were registered, and more than 50 were seated at each meeting.


Among the outstanding features of the convention was the announcement that about 150 new members had joined the society during the year, as a result of which the receipts had exceeded the expenditures by more than a thousand dollars; and the adoption by the convention of a new constitution, which now goes to a letter ballot of the society.

It is expected that the next convention will be held in New Orleans at a date to be fixed later on. The officials elected for the year 1931-'32 are: President, J. H. Neeson, Philadelphia; first vice-president, Samuel A. Greeley, Chicago; second vice-president, Charles M. Reppert, Pittsburgh; third vice-president, H. P. Eddy, Jr., Boston; treasurer, Hymen Shifrin, St. Louis. Secretary Sammelman was reappointed.

The proposed constitution provides for a pronounced change in membership classification, and in provision for local chapters; otherwise it follows the present one in its general provisions. The membership would be of three classes only—Members, Associate Members and Affiliate Members. The first would include all engineers connected with municipal work, whether employed by municipalities or by commercial organizations, who have had twelve years of active practice; at least five in responsible charge of work. The second would include all engineers so connected, but with less experience. The third class would include all not qualified for the first two. Only the first two classes can vote or hold office.

New England Water Works Association

The 50th annual convention of this association, which was held at Boston, Mass., September 29 to October 2, was well attended, and the technical sessions were of a high order. The opening meeting was devoted mainly to business matters and to the award to Frank C. Ha'e of the Dexter Brackett memorial medal. In the afternoon, historical papers were presented covering the association, the Boston water works and water works trends and practices for the past 50 years. Wednesday was "Superintendents' Day" and the discussions revolved about emergency problems concerning which there were papers and discussions by J. D. McMahon of the



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WIRE AT OUR EXPENSE FOR RESERVATIONS
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MANAGING DIR.

Mathison Alkali Works, Harry U. Fuller, H. W. Griswold, W. J. Scott, T. F. Bristol, George F. Merrill, and others; tuberculosis was discussed in a technical way by H. G. Reddick and S. E. Linderman of the United States Pipe and Foundry Co., and by Charles W. Sherman, Roger Esty, Malcolm Pirnie and D. A. Heffernan.

C. W. Mowry opened the afternoon session with a paper on "Water Consumption During Fires" (which appears on another page of this issue in abstracted form). Following this there was a general discussion on various waterworks practices in which a number of superintendents joined.

Speakers at the Thursday morning session presented a symposium on water

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Standard Cut-Back Surfacing Asphalt.
 Standard Asphalt Binder A for surface treatment.
 Standard Asphalt Binders B and C for penetration work (Asphalt Macadam).
 Standard Paving Asphalt 51-60 and 61-70 Penetration for the mixing method. (Asphaltic Concrete.)
 Standard Cold Patch Asphalt for all types of patching.
 Standard Refined Asphalt for sheet Asphalt paving.
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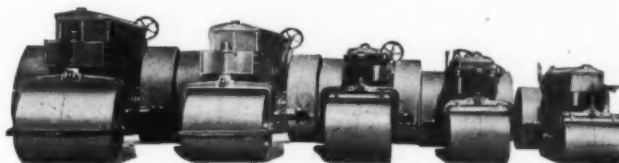
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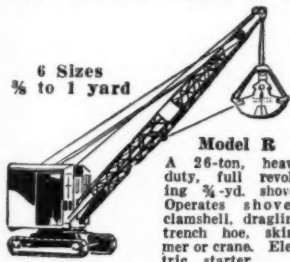
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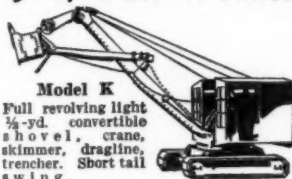
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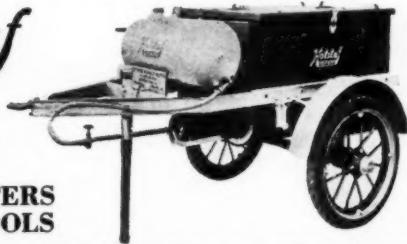
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 POURING POTS, ASPHALT SPRAY PUMPS**

Dealers in Principal Cities

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purification in New England. Those speaking included R. S. Weston, Melville C. Whipple, Fred E. Smith, E. L. Bean, W. A. Gentner and H. C. Chandler, representing Cambridge, Providence, Hartford and Greenwich, respectively. In the afternoon the allocation of interstate waters for supply purposes was discussed by a number of speakers with Thaddeus Merriman and Frank E. Winsor leading.

George W. Brehm, Waltham, Mass., was elected president of the association and E. Sherman Chase of Boston, vice-president.

New York State Sewage Works Association

The fall meeting of the New York State Sewage Works Association was held at Ithaca, N. Y., October 16-17, 1931, J. F. Skinner presiding. The total registration of members and guests was 96, including 16 ladies.

Following a brief business meeting the afternoon session was devoted to a paper on "Sedimentation Tank Design and Performance" by Glenn D. Holmes and a symposium on Stream Pollution. Mr. Holmes' paper described the experimental work and the actual full design tank performance at Syracuse and was illustrated by numerous charts thrown on the screen.

In the symposium Professor Chamot of Cornell University discussed stream pollution as it affects water purification, Professors J. G. Nedham and P. W. Claassen of Cornell University discussed stream pollution as it affects biological life and Dr. Emmeline Moore of the New York State Conservation Department gave a paper on stream pollution as it affects fish life.

At the dinner in the evening Dexter S. Kimball, Dean of the Engineering College of Cornell University, was the principal speaker, using the theme of the past and present status of the sanitary engineer. He referred particularly to the Short School for sewage works operators that the Association has undertaken and offered the facilities of the university for any assistance that might be needed.

Following the dinner, C. H. Capen of West Orange gave a paper with lantern slides on "Camouflaging Sewage Treatment Plants" and Professor W. C. Taylor of Union College opened a discussion on "Measuring Devices in Sewage Treatment Plants."

Prior to the Saturday morning inspection trip to the Ithaca Sewage Treatment Works and University Water Purification Plant, Professor H. N. Ogden, Messrs. Earl F. O'Brien and Harry Eustance gave a description of the sewage treatment plant and its operation since redesign.

At the meeting of the Executive Committee it was decided to hold the next short school for sewage works operators at Cornell University at the time of the 1932 spring recess.

The Fourth Annual Meeting of the Association will be held in New York City on January 19, 1932.

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